CANADIAN ENVIRONMENTAL ASSESSMENT ACT
SCREENING REPORT

(DRAFT)

Proposal by

New Brunswick Department of Transportation
New Brunswick Department of Environment
Fisheries and Oceans Canada
Environment Canada

for the

Petitcodiac River
Trial Gate Opening Project

Fisheries & Oceans Canada
Environment Canada
January 13, 1999

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PART A

PROJECT INFORMATION

Project Name:	**Petitcodiac River Trial Gate Opening**
File Reference: (DFO Habitat Management)	5312-2-96-004 General 5312-2-96-004 Mon 5312-2-96-004 Eng 5312-2-96-004 EA
Project Location:	Petitcodiac River at Riverview, New Brunswick Latitude 46°03.90N, Longitude 64°48.40W
Proponents:	N.B. Department of Transportation N.B. Department of Environment Fisheries and Oceans Canada Environment Canada
Contact Persons:	**Steering Committee Members:** Ms. Diane Kent Gillis (Chairperson) N.B. Department of Environment Mr. George Haines N.B. Department of Transportation Mr. Maurice Levesque Fisheries and Oceans Canada Dr. George Finney Environment Canada

PART B

ENVIRONMENTAL ASSESSMENT SUMMARY

1. Establishment of Responsibility

The proposed project is a trial opening of the Petitcodiac River causeway gates as described in a Memorandum of Understanding (MOU) signed by the New Brunswick Department of Transportation, New Brunswick Department of Environment, the Department of Fisheries and Oceans, and Environment Canada in 1996. The MOU made provision for sharing of costs and for project planning, implementation, monitoring and evaluation. In considering a proposed trial gate opening for 1999, both federal departments have conducted an environmental assessment which will address, in an efficient and proactive manner, relevant environmental issues concerning the trial gate opening. Both federal departments are considered Responsible Authorities under the Canadian Environmental Assessment Act (CEAA).

2. Scope of Project to be Assessed

While river flow and weather conditions will influence the exact start time, the project is anticipated to begin as early as April 1, 1999 after the causeway gates are operated to clear the head pond of ice and to pass the spring freshet flows. The beginning of the project would occur with pre-trial flushing and the drawdown of the head pond. Then will follow the trial gate opening itself once the river flow is low enough to allow the management of the gates as described in the Gate Operation Plan discussed in Part B of this report. The project will end with the refilling of the head pond upon completion of the trial. The project may run until November 30, 1999 but could be considerably shorter.

After the project, all four government departments will continue to do some monitoring related to the trial gate opening (as outlined in the Monitoring Plan in Attachment 1), but nevertheless outside the scope of this project.

3. Type of Assessment

The environmental assessment is in the form of a screening. The screening makes use of the environmental assessment conducted for the proposed 1998 trial gate opening to the extent it remains applicable. The screening also takes into account the results of monitoring conducted during 1998 including monitoring during pre-trial flushing.

The proposed project is an undertaking that must be registered under the Environmental Impact Assessment Regulation of the New Brunswick Clean Environment Act. In the spirit of the January 1998 Environmental Harmonization Accord, and the accompanying Sub-Agreement on Environmental Assessment, the federal government will take the lead in the environmental assessment to avoid duplication of process. The New Brunswick Minister of the Environment has indicated that a decision under the provincial process will be based on the results of the federal screening that includes the participation of provincial government agencies with pertinent expertise.

4. **Environmental Assessment Start Date:** October 9, 1998

5. **Environmental Assessment Contacts:**

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Fisheries and Oceans Canada
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Moncton, New Brunswick
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RitchieB@mar.dfo-mpo.gc.ca

Mr. Jean-Guy Deveau
Environment Canada
P.O. Box 23005
Moncton, New Brunswick
Telephone: (506) 851-7729
jean-guy.deveau@ec.gc.ca

6. **Public Registry Information**

Public Registry Officer:

Mr. Maurice Levesque
DFO Habitat Management
P.O. Box 5030
Moncton, New Brunswick
Telephone: (506) 851-7768

7. **Project Background**

The Pointcodiac River Causeway was built in 1968 as a joint venture between the Province of New Brunswick and the Federal Government represented by the Maritimes Marshland Reclamation Administration. The structure obtained all necessary reviews and permits required at the time from provincial and federal regulatory bodies.

Studies conducted in the years following the completion of the structure confirmed that the causeway and gate operations have significantly impeded upon upstream and downstream diadromous fish migration. In consultation with various agencies, the New Brunswick Department of Transportation (NBDOT) has undertaken major renovations to the gates and fishway over the years and adjusted its gate operation several times in an attempt to improve fish passage, flush accumulated sediment, and prevent head pond shoreline erosion.

In April 1995, a proposal to study the operation of the gates was submitted to the Premier's Round Table on the Environment and the Economy by Dr. Alyre Chiasson of the Université de Moncton. In February 1996, the resulting report, funded by the Environmental Trust Fund, was submitted by ADI Limited to Dr. Chiasson. The ADI Report, "Technical Evaluation and Monitoring Program for an Option to Operate the Gates to Clip the Tides at the Petitcodiac River Causeway", studied options to partially restore the natural ecosystem of the Petitcodiac River.

The provincial Departments of Transportation and the Environment, and the federal Departments of Fisheries and Oceans, and Environment, having long-standing involvement in the issue, reviewed the ADI Report with their own staff and with other experts. They accepted to proceed with an implementation, monitoring, and evaluation of a trial gate opening based on an approach contained in the ADI Report. To this end they developed a Memorandum of Understanding (MOU) which was signed on December 5, 1996. The Signatories identified a Steering Committee and Working Group structure to implement the trial.

The Monitoring Working Group (MWG), in conjunction with the Engineering and Design Working Group (E & DWG), are ensuring that equipment and procedures will be in place so the necessary physical monitoring is fully carried out. The E & DWG is tasked with producing a gate operation plan to be used during the trial gate opening.

The multi-stakeholder Monitoring Working Group is tasked with preparing a plan for monitoring some key environmental parameters before, during, and after the trial. The information collected and produced would be available should an Environmental Impact Assessment registration for a long term proposal be forthcoming.

It is the responsibility of the Public Participation & Communications Working Group (PP& CWG) to ensure that the public is kept informed of all aspects of the project both prior to and during the project.

In 1998, pre-trial flushing was undertaken in an attempt to establish the river channel conditions that were required before proceeding with an opening of the causeway gates to allow tidal water intrusion upstream of the causeway. Due to delays in initiation of the flushing exercise, the prerequisite conditions could not be established. Therefore, the trial gate opening was postponed until 1999.

Both the federal and provincial governments have decided to proceed with a coordinated and harmonized environmental assessment process based on the Canadian Environmental Assessment Act (CEAA). The Province of New Brunswick has also advised that further related action beyond the specified trial period, including continuation of the trial, would not be permitted without such project being registered through the Environmental Impact Assessment Regulation under the Clean Environment Act.

The approach selected seeks to address fish passage and ecosystem issues related to the causeway structure. The short-term trial is designed to investigate uncertainties raised in the report related to river bank and structure stability, and erosion protection requirements. The opportunity will be taken to collect environmental and other data which may be useful in making long-term decisions regarding the causeway/gates.

7.8 Monitoring

A Monitoring Plan was developed, in consultation with the public, in 1997 and has been updated for the 1999 trial gate opening project. The WWC has conducted trial-related monitoring in the watershed since 1997 in preparation for a trial in 1998 and 1999. The 1997 results have been released and the 1998 results are being analyzed and compiled. The updated Monitoring Plan has been approved by the Steering Committee for release to the public.

7.9 Communications

The PMG/CWG held Open Houses in Riverview and Moncton in preparation for a trial gate opening in 1998 to provide the public with the latest information on the trial prior to its commencement and to respond to any questions that might be raised. Open houses will also be held in early 1999 in the Greater Moncton area and also in several other locations throughout the watershed.

7.10 Gate Operation

A Gate Operation Plan (GOP), developed by the E & DWG, was approved by the Steering Committee and released to the public prior to the attempted trial gate opening in 1998. The GOP has subsequently been adjusted given the information and insight learned from the 1998 pre-trial flushing. A decision-making mechanism is included in the GOP to ensure the trial proceeds as closely as possible to the terms and objectives of the WEP. Such decisions must maximize fish passage opportunity and not compromise reversibility of the trial. Reversibility is defined in terms of sedimentation of the head pond.

The Petitcodiac River Causeway, built in 1968, has five sluice gates operated by an electrically powered cable system and 2 fishways. Presently the gates and fishways are operated to meet the following objectives:

- to prevent fish other than the Nooksack bull trout except for listed fishery activities (section);
- to maintain bull trout elevation up to a maximum of six inches (operational fluctuation to occur);
- to control bull trout flooding by spilling excess Nooksack River flows and storing them in the bull trout pool as necessary;
- to operate the vertical slot fishery throughout the year;
- to operate the Cable Prairie fishery with the special angling from April 1 to November 15 or as to provide attraction water near the fishery and to opening gate 7 when the levels fall below the bull trout level and allowing overflow as a special gift across to the upper trapping;
- to flush sediment accumulation in the river channel, in particular near the gate;
- to control potential for gate to be inadequate by lowering the bull trout level to the same and having spring to break up; and
- to control detention system.

The operation of the gate during the trial will be based on the report, "Technical Evaluation and Monitoring Program for an Option to Operate the Gates to Flip the Tides at the Nooksack River Estuary" (herein referred to as the VEE Report). Scenario 1, Approach B, and is accordance to the basic concepts in the VEE statement. The trial is scheduled to begin in the spring of 1999. Before the trial can start, the gates will be operated at least to clear the bull trout elevation and to pass the spring freshet flows. The water release results in the flushing of much of the sediment accumulated in the river channel upstream and downstream of the structure.

Further sediment removal from the channel is accomplished each spring by holding the bull trout elevation at about 10 meters, then releasing the water through one of three gates at the 4th, generating sufficient velocities to maximize sediment removal. This process is repeated until as much of the sediment deposits upstream and downstream of the structure are removed.

Historical data, including the 1998 bathymetric survey, confirm the normal spring freshwater management results in channel scouring to approximately elevation 7.5 meters at the Cunningsville Bridge. The 1999 pre-trial bull trading season will start after normal freshwater management when the gates are opened to maintain downstream sediment transport and suspension forecasts. In conjunction with river discharge and water level monitoring, will assist in determining when to start the pre-trial fishing season. It should be noted that during this process, the elevation of the bull trout will fluctuate considerably. It should also be noted that during the pre-trial fishing, no fish kill water releases will occur.

The next step will be drawdown of the bull trout until river flow is low enough and the bull trout channel is sufficiently cut to maintain the bull trout water level below elevation 3.7 meters during a full tide cycle. During the drawdown period, the Monitoring Working Group will be monitoring the possibility of fish stranding. If the outlook is that a significant number of fish become stranded, the Monitoring Working Group will recommend contingency measures.

[illegible]

Comprehensive records will be kept on the gate operation and the resultant water elevations immediately upstream and downstream of the structure. These data will be compiled by the NBDOT Local Team engineer, made available to the Working Groups throughout the project and will be used for further analyses following completion of the trial.

7.8.3 Project Operational Considerations

The two main objectives guiding the gate operations will be to operate as closely as possible to the target elevation of 2.5 metres during the trial and, while operating within that parameter, to maximize the opportunity for fish passage.

The trial is unlikely to be conducted with continuous average water conditions as was modeled in the ADI Report. High freshwater flow conditions could reduce the period during which the gate would normally be opened on an incoming tide. Low freshwater flows could cause sediment build-up. Should these or other natural conditions prompt decisions concerning the suspension, termination or modification of the trial, the following guidelines will apply:

i) **Public Safety**

The project shall be suspended if there is immediate and serious risk to public safety or to the structural stability of the gate structure or causeway. This decision will be made by the NBDOT District Engineer or his designate and immediately communicated to the Steering Committee Chair for decision on resumption of the project or termination. Such a decision will be made by the Steering Committee, in consultation with the Working Groups, within ten working days of notification.

ii) **Weather and Other Emergencies**

In the case of an emergency situation brought about by extreme weather conditions, earthquake or other factors that cannot be reasonably predicted, the project may be suspended until these conditions pose no further risk to the structure or public safety. This decision will be made by the NBDOT District Engineer or his designate and immediately reported to the Steering Committee for decision on resumption of the project or termination. A decision will be made by the Steering Committee, in consultation with the Working Groups, within ten days of notification.

iii) **Water Levels**

Should it become evident that sediment deposition downstream of the gates and/or high freshwater flows may compromise the ability to control upstream water levels at the target elevation, the District Engineer or his designate shall notify the Engineering and Design Working Group as soon as such concerns are identified, for direction or action to be taken. The Working Group will recommend a preferred course of action within five days of notification to the Steering Committee, who will provide direction within five days on a course of action.

6) *Fish Passage*

- Both fishways will be closed from November 30, 1998, until the head pond is refilled following the end of the trial.

- From November 30, 1998 until the start of normal ice management in the spring of 1999, fish passage will not be provided. The Department of Fisheries and Oceans has agreed to the closure of the vertical slot fishway over the winter months to prevent unnecessary mud build up in the head pond. This closure is considered acceptable as there is no known fish migration during this time period.

- From the start of normal flood water and mud management to the commencement of the trial, at least one gate will be kept fully open on a rising tide up to the point where tidal water reaches the same elevation as fresh water upstream of the causeway.

- For the duration of the trial the gates will be managed as described in Scenario 1, Approach B of the ADI report.

- Following the trial both fishways will be operated normally after the head pond has been refilled.

Fish passage opportunity will be assessed by the Monitoring Working Group. Should fish passage be impeded during the project, both the Monitoring Working Group and the Engineering and Design Working Group, in consultation with the NBDOT District Engineer or his designate, will provide a recommendation to the Steering Committee within two days. The Steering Committee will provide direction within two days of this notification to ensure compliance with the Fisheries Act. The Chair of the Engineering and Design Working Group will provide the direction from the Steering Committee to the District Engineer on the action to be taken.

9) Physical Damage

Should erosion resulting from the project threaten physical damage to a public building, land or structure, mitigation measures may be required. The Engineering and Design Working Group will recommend to the Steering Committee mitigation measures within five days of notification. The Steering Committee will provide direction within five days.

All of the foregoing response times are maximums. It is clearly planned that all four agencies directly involved with the project will follow the progress of the trial very closely on a day to day basis. Authorized staff will be available at all times to make decisions as may be required.

vi) Further Situations That May Arise

Further, the Engineering and Design Working Group has identified four(4) specific situations, some of which relate to the foregoing, that may arise during the project. These are:

1) Channel wandering in a manner which threatens to damage public infrastructure;

2) Sedimentation of the upstream channel that threatens attainment of the 2.5 metre target;

3) Rainfall conditions threatening the objectives of maintaining a minimum freshwater flow; and

4) River bank slumping resulting from river channel cutting.

The Engineering and Design Working Group will develop additional guidance to assist the Steering Committee in any decisions that might be required from the pre-trial flushing exercise to the refilling of the head pond upon completion of the trial. Such guidance will be consistent with the foregoing processes and will respect the main objectives of the trial, in particular fish passage requirements. In addition, with the assistance of the Monitoring Working Group, they will propose additional detail on how the impending development of such scenarios will be identified, verified and communicated in a timely manner during the trial.

All communications by the Engineering and Design Working Group to the Chair of the Steering Committee, with respect to changes in operating conditions, will be copied to the Chairs of the other Working Groups.

8. Purpose of Project/Need for Project

Not all questions related to environmental and fisheries implications can be answered within the limited duration of the project. However, valuable environmental and fisheries data, as well as information related to channel erosion and stream morphology, will be collected to serve as the basis for future decision making (see monitoring plan, Appendix 1).

The approach of proceeding with this limited trial gate opening will allow for the prudent and step-wise progression toward the long-term goal of improving and/or restoring fish passage and the ecology of the watershed.

9. Alternate Means of Carrying Out the Project

The ADI Report (1996) examined three different approaches or options for operating the tidal gates which would allow tidal water upstream while protecting upstream areas from flooding. In addition, 3 separate scenarios for controlling the upstream flow regime were explored. Prior to the selection of the option/scenario for the trial gate opening, alternatives were examined through a cost/benefit analysis which considered a wide array of environmental factors including fisheries, hydraulics, transportation, recreation, tourism, and water quality.

PART C

CONSULTATIONS

1. Public and Municipal Participation on Working Groups

The Monitoring Working Group (MWG) includes, in addition to the four signatory agencies, representatives from the municipalities of Moncton, Dieppe and Riverview, as well as two non-government interest groups, which represent the range of positions on the issue of the causeway gate opening. These groups are the Lake Petitcodiac Preservation Association (LPPA); and the New Brunswick Wildlife Federation. All MWG members participated in the development and revision of the Monitoring Plan.

2. Public Comment and Input

The MWG submitted a draft Monitoring Plan to the Steering Committee in June 1997. The draft plan was released on July 23, 1997, and public input and comments were accepted until August 23, 1997. Based on public feedback received as well as on ongoing monitoring activities, a revised Monitoring Plan was submitted to the Steering Committee in November 1997. Pre-trial monitoring continued in 1998, as the trial opening was postponed to 1999, and the MWG therefore updated its Monitoring Plan once again in December 1998. The current Monitoring Plan is included in this report (Appendix 1).

Open house information sessions were held in Riverview and Moncton on March 11-12, 1998, to provide the public with the latest information on the trial gate opening prior to its commencement, to respond to any questions that may be raised, and to solicit further comments from stakeholders. All such written comments were considered in this environmental evaluation.

On April 24, 1998, a letter was sent to Lake Petitcodiac Preservation Association (LPPA), Friends of the Petitcodiac, and all identified stakeholders. The purpose of the letter was to provide them with an update on the status of the trial gate opening and the environmental assessment being carried out, and to seek their further input by May 8, 1998, on matters that they felt should be considered in the assessment. A list of previously-identified issues was attached to the letter as a starting point.

Copies of this screening report for the 1999 trial gate opening project will be made available to the public for comment. Any input received within the specified time will be evaluated and considered before final assessment determinations are reached.

3. Issues Identified

Based on the input summarized above, the following list of issues to consider in the environmental assessment process was compiled as follows:

TABLE I

Issues/Concerns	Where Issue Is Addressed in Report (Page No.)
• Include other aspects in the study: sounding study of the River (from Salisbury to Memramcook); computer animated visual of the DOT data on the deposits of the River.	Appendix 1 (74-82)
• Look at the erosion problems, especially at Fox Creek.	30-31, 57
• Far more silt has moved back into the bay this spring than will be re-suspended during the experiment.	30-31, 47
• Restore the river because there is a reduction of the width and the depth of the river, an increase of silt and disappearance of fishes.	21-26, 31
• The Petitcodiac River silt accumulation is almost reaching Hopewell Rocks and is threatening that tourist region.	30-31, 52
• Some rare species of migrating birds that lived at Mary's Point now have to live further down in the Shepody Bay. One species of shrimp which they feed upon cannot survive in the mud that is accumulating.	27, 43, 51-52
• We fear the extinction of the salmon in the next few years, unless we reestablish the natural flow of the river.	21, 41, 53
• Very worried with the dramatic accumulation of sediment in front of the Bore Park (the river is no longer visible from the viewing area). What will happen this summer and a few years from now? Is there any reason to think that the effects are not going to appear eventually at Hopewell Rocks and Mary's Point marine bird's sanctuary?	47
• If nobody acts to open the gates, things are going to continue to deteriorate (to the day where an important part of the river will be only a brook). What will eventually happen to the animals that survived until now in this region?	41-45

Issues/Concerns	Where Issue Is Addressed in Report (Page No.)
• There is a healthy environment for fish not far below the causeway gates that could also be enhanced by this decision.	42-43
• In June 1988, all five gates were opened and the fish came back to the river. The fishermen were catching between 1500 to 2000 pounds of shad at each tide, for a period of three weeks; then the gates were closed again and everything died again.	21-23
• People can no longer accept that a minority of citizens ignorant of the importance of preserving our ecosystems can take from the rest of the population a fundamental piece of their natural and cultural heritage. What will we have to pass on to the next generations?	4, 5, 10
• There needs to be a full scale, unbiased environmental assessment.	4, 5
• Federal and Provincial Governments are spending good taxpayers' dollars to save a few salmon.	10,21
• How do you propose to reverse the outcome of this experiment if the erosion into the landfill sites results in dangerous contaminants being deposited throughout the river valley, from Alma to Salisbury?	50, 52
• Fundy lobster and scallop fishermen are concerned about contamination from sediments moving downstream, smothering their fishing grounds, contaminating fish and destroying their livelihood.	42,47, 51-52
• The trial opening of the Causeway Gates proposed for the spring '98 will cause vast quantities of silt to be deposited on the lobster and scallop habitat found in the upper bay area.	42, 47, 51-52
• The loss of the lobster and scallop habitat in the upper bay and/or a loss of public confidence in seafood products harvested from this area would cause a severe economic decline in many small fishing communities along the upper bay that rely on this fishery.	42, 53, 54
• How do scientists propose to reverse the in-filling of the lake area?	5-11

Issues/Concerns	Where Issue Is Addressed in Report (Page No.)
• Baseline data is a key issue in such an experiment. Why has there been no one monitoring the recent siltation problem downstream of the gates?	46, Appendix I (p. 73)
• The hydrology measurements during the spring freshet are the most important requirements in doing any models of the river. Is this completed?	76
• What are the combined effects of all the "temporary" environmental manipulations that have occurred in the Petitcodiac River since the causeway?	6, 21-30
• Because of clear cutting in the watershed's main tributaries of the river, there is now insufficient water to flush the main river adequately. (The tidal water is silt laden, so how can it accomplish flushing?)	6-7, 30-31
• Concern with dust bowl effect of dried mud flats (lake side).	52, 53
• Major concern for the loons (and their young that will surely die) which have made their home on the lake, and for other species that will surely suffer the same fate.	43
• Smelling death and decay from marine life that cannot survive without the lake.	53
• Opening the flood gates to tidal saltwater will:	
◦ Kill a freshwater ecosystem (there is a new ecosystem developing on the lake).	24, 25, 42
◦ Pollute the environment upstream with sewage waste that is only minimally treated and with toxic substances that are leaching from the old landfill site.	48-51
◦ Erode river banks, underground water and sewer pipes, Gunningsville bridge piers, flood gates...	47
◦ Infill the lake with sediment from below the causeway and greatly reduce the water depth.	47
◦ Create an additional 20 km of waterway unsafe for recreational activity.	56
◦ Displace or kill freshwater plants and animals (include fish, amphibians, aquatic insects).	41, 42

Issues/Concerns	Where Issue Is Addressed in Report (Page No.)
Increase breeding grounds for saltwater mosquitoes (will they spray toxic chemicals to combat them?)	45
• What kinds of contaminated residue are expected to remain in the headpond area after the experiment is completed?	51, 52
• What public health warnings are going to be issued above the causeway during this experiment?	49
• Where is the list of species that are expected to die off during this experiment?	41-45
• Has consideration also been given to all the legislation (fish habitat laws, watercourse alteration act, endangered species act etc.) that will be violated by this experiment? If so, where is the documentation?	N/A
• In terms of biological diversity, what will be the impact of changing from a saltwater habitat in summer and changing back to freshwater habitat during the winter?	41,42
• Will you give consideration to the fact that you will have deprived all these people their considerable enjoyment (boating, walking, swimming (dogs), fishing, observing nature), during the entire summer and fall of 1998?	55-57
• Will you make the screening report available to the public?	Yes
• Not reassured by the notion that the group of scientists will conduct a meaningful and objective review of the issues before the proposed experiment.	CEAA process followed
• Unconvinced that "much of the information necessary to conduct the screening has already been gathered and considered," so the screening process will inevitably be flawed and will lack legitimacy.	21-40 Appendix 1

Issues/Concerns	Where Issue is Addressed in Report (Page No.)
• If the lake is not full for freeze-up at the beginning of next winter, then events (Maritime Snowmobile Festival) cannot be planned for the lake and the main snowmobile crossing on the lake may not be safe for use	56
• If the property values drop because the lake is gone, we will be seeking compensation and lowered valuation.	57,58
• Landowners (near the lake) will potentially lose money if the lake does not remain.	57,58
• Riverview Tour Boat Ltd. operated in the summer of '95 and '96. They had 325 paying passengers. We hope that whoever is going to make the final decision will look at the economical side as well.	38, 55-57
• How do you intend to compensate us for our social losses and the emotional stress that this experiment has and will continue to cause us if this experiment proceeds?	N/A
• And, how do you intend to compensate the environment (i.e. governments no net loss policy)?	10
• If all of this (lake's ecosystem) has to "die", we want complete assurance from the government that the gates will be left open permanently.	10, 41-42
• Lake Petitcodiac is a Canada geese staging area.	27, 43
• It would cost too much money to repair the river adequately, the river will likely never be restored to what it was (pre-causeway). So what would be the point? It would only silt in again because it is a tidal river.	10

6. Public Opinion

A public opinion poll, conducted by Corporate Research Associates in the greater Moncton area on April 28-30, 1998, found that 54% of people surveyed favoured a permanent opening of the Petitcodiac Causeway gates. Eighteen percent (18%) said the gates should be permanently shut while 20% said they did not know or had no opinion. Only 5% favoured neither option while 2% said further environmental study was necessary. Respondents were asked the following question: "As you may or may not know, there is currently a debate about whether or not to open the causeway gates on the Petitcodiac River. For you, personally, do you think the gates should be permanently opened, the gates should be permanently shut, neither, need environmental study or don't know/no opinion?" (Moncton Times & Transcript, May 15, 1998).

A second public opinion poll commissioned by the Times & Transcript newspaper and conducted by Corporate Research Associates between August 4-6, 1998 (after the pro-rata flushing attempt and postponement of trial gate opening) indicated a decline in public support for permanent opening of the causeway gates in the Metro Moncton area. 47% of Metro Moncton residents supported a permanent opening of the causeway gates while 34% were in favour of keeping the causeway gates permanently closed. Another 19% were undecided.

In both cases, the opinion poll only covered the Greater Moncton area and did not cover the entire Petitcodiac River watershed. In both polls, four hundred (400) adults were contacted and the polls are considered accurate to within 4.9%, 95 times out of a hundred.

8. Government Consultations

8.1 Federal Authorities

Fisheries and Oceans Canada, Science Branch
Fisheries and Oceans Canada (Canadian Coast Guard), Navigable Waters Protection Program
Environment Canada
Canadian Environmental Assessment Agency
Department of Justice

8.2 Provincial Authorities

New Brunswick Department of Environment
New Brunswick Department of Natural Resources and Energy
New Brunswick Department of Transportation
New Brunswick Department of Health and Community Services
New Brunswick Department of Agriculture

5.0 Municipalities

City of Moncton
Town of Riverview
Town of Dieppe

5.0 Native Governments

Chief Joseph Knockwood
Fort Folly First Nation
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6. Other Agencies

Greater Moncton Sewerage Treatment Commission
Greater Moncton Pest Control Commission

[redacted]

[redacted]

8. Project Boundaries

[redacted]

[redacted]

[redacted]

[redacted]

8. Description of Existing Environment

8.0 Hydrology

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

The Nottcodee River Causeway (Causeway) is located in the mid-portion of the river and was constructed in 1968 primarily to provide a road connection from the City of Shawnee to the western Town of Riverview and to provide tidal flooding protection to agricultural land upstream of the causeway. The causeway is a rock-filled structure, 375 m long and incorporates [illegible] operated tide gates. A 10 foot vertical tide fishway was incorporated into the eastern end of the gate structure. The causeway has created a 90 hectare freshwater wetland extending to the confluence of Cole & the Village of Gallsboro.

The Nottcodee River estuary is subject to the type tidal variations of Chippewa and Shipyard Bays and rising tide mixed system in the form of a wave. Effects of the tidal flow reached Gallsboro prior to causeway construction, but the tide is presently limited to the area downstream of the causeway.

5.2 Biophysical Setting

Valued Environmental Components

5.2.1 Fish and Fish Habitat

a) Fish

Historic salmon (Some info)

The Atlantic salmon is an important recreational species in New Brunswick and is considered vulnerable due to habitat degradation and overfishing. Annual runs of Atlantic salmon in the Nottcodee River, prior to completion of the Nottcodee Causeway, were estimated to be 2000-3000 fish (Downey, 1995). Estimates of production potential in the river, based on habitat mapping, indicate that stocks of up to 5000 fish could be supported. Fishway logs were reviewed for evidence of returning adult Atlantic salmon derived historically following construction of the causeway. Inefficiencies in fish passage are identified as probable cause. Efforts to restore stocks through fishway modifications and stocking programs have not resulted in significant increases in returning adult salmon, which remain at or at the low. Only 2 salmon were counted in the fishway in 1993, followed by 18 counts between 1994 and 1998. Salmon parr were sampled during 1997 electrofishing surveys at three locations in the Little River and at one site on the Potter River (Chapin, a Environmental Monitoring Working Group (MMWG), 1998).

American shad (More significance)

Loom and Scott (1960) reported that the Nottcodee River, prior to construction of the causeway, was one of the more important shad producing rivers in the Maritimes. Shad now has a non-migratory model and the opening run on the Nottcodee enters the river in May and uses the resulting oxygen and the system is possible to support through October. 510 Shad reported that the fish passed in the main Nottcodee River and possibly in the lower few miles of the of

its major tributaries (Pollett, North, Anagance, and Little [Cloverdale] Rivers and Turtle Creek). Extremely low fishway counts (1 and 19 and 0 during 1971, 1972 and 1973 respectively) following causeway construction demonstrated the inability of the structure to pass this species. Shad have not been counted in the fishway since 1983 (Dupuis, in MWG, 1998). Following the opening of the gates in 1988, anglers reported that shad were more abundant upstream of the causeway. Shad are plankton feeders and a large migration of mixed stock and age class fish from various rivers along the Atlantic seaboard migrates into the Upper Bay of Fundy in early June, departing in early October (Dadswell, 1987).

Gaspereau (Bluebuck herring [*Alosa Aestivalis*] and Alewife [*Alosa pseudoharengus*])

Gaspereau enter the Petitcodiac to spawn between May and mid-July. Elson reported that the still waters of the Anagance River was the primary spawning area for these species although they had been captured in experimental traps on the Pollett River. North River provided lesser amounts of spawning habitat. Creation of the headpond may have provided additional spawning habitat for alewives, but numbers of gaspereau passing through the fishway have been consistently low. The creation of the headpond would not have greatly enhanced the production potential for these fish. Gaspereau, of the same genus as shad, have similar problems in negotiating the fishway. A fishway count of only 360 fish occurred in 1972 (down from 3,354 in 1971) which coincided with a considerable reduction in the commercial catch that year. This would have been the first returning year class from fish spawned after causeway construction. Semple reported that gaspereau passage may be enhanced when the causeway gates are opened for maintenance purposes. As with shad, anglers reported higher numbers of gaspereau upstream of the causeway in 1988 following the opening of the gates. In 1997, 87 gaspereau were counted in the fishway trap (Dupuis, *in* MWG, 1998). Both species were sampled in the headpond during 1997 surveys (Chaput, *in* MWG, 1998).

Smallmouth bass (*Micropterus dolomieui*)

This species has been illegally introduced upstream of the causeway. The time of introduction, numbers, and movements of these fish in the Petitcodiac system are largely unknown, although there has been some angling success at the mouths of tributaries flowing into the headpond. Small numbers of these fish were sampled during surveys of the headpond in 1997 (Chaput, *in* MWG, 1998).

Rainbow smelt (*Osmerus mordax*)

Smelt ascend the Petitcodiac River in April and May during their spawning migration. Counts of 11,548 and 360 fish were recorded in the causeway fishway during 1971 and 1972, respectively. The fish passage facility, based on current knowledge, is not considered to provide efficient passage for smelt (H. Jansen). Following opening of the causeway gates in 1988, smelts were reported to be more abundant and distributed farther upstream than during the years following causeway construction. Suitable substrate for smelt spawning is present in all tributaries of the headpond and in the main river above Intervale Creek (Locke and Klassen, *in* MWG 1998).

Striped bass *(Morone saxatilis)*

There are no records to suggest that the Petitcodiac River has had a spawning run of striped bass although some angling for this species has occurred upstream of the causeway. Five fish were counted in the fishway in 1971 and four in 1972. Two striped bass counted in the fishway in 1985 are the last on record.

Brook trout *(Salvelinus fontinalis)*

Historical records indicate that large runs of anadromous brook trout (sea trout) occurred on the river. There is, however, a lack of detailed information on this species and general declines in this resource have been observed throughout the Maritime Provinces. Fishway trap operations in 1971, 1972 and 1983 did not record any sea trout although the facility would have trapped only the larger fish. Two (2) were captured in 1987 and 1 in 1989 (Dupuis, *in* MWG, 1998). Anglers reported higher sea trout catches in 1988 following the opening of the gates that year. Resident (non-anadromous) brook trout are widespread throughout the Petitcodiac River and its freshwater tributaries and were sampled during electrofishing surveys in 1997 (Chaput, *in* MWG 1998).

American eel *(Anguilla rostrata)*

Historical records indicate that large numbers of catadromous American eels migrated up the river and Elson reported that eels utilized from one half to one quarter of the river's producing capacity. Eels have been counted in the fishway although numbers have been low in recent years (6 counted in 1997). Eels were sampled during electrofishing surveys in 1997 (Chaput, *in* MWG 1998).

Atlantic sturgeon *(Acipenser oxyrhynchus)*

The Atlantic sturgeon is an anadromous bottom-dwelling species found within the Petitcodiac estuary where it has been pursued by the commercial fishery (See section 2.3.1).

ii) Fish Habitat

Headpond

The headpond upstream of the causeway is a very young, frequently disturbed freshwater ecosystem. These disturbances include drawdowns (opening of causeway gates) for ice and mud management and to drain excess flows during spring freshets, snow melts and storm events. The freshwater ecosystem is essentially ten years old following the full drawdown in 1988 when the headpond was returned to tidal conditions. Effects of other disturbances, including an emergency drawdown in 1997 are reflected in its aquatic community structure. In addition, an extensive amount of sedimentation from downstream sources, and lesser amounts from upstream sources, has occurred in the headpond since its construction in 1968. Some physico-chemical parameters were monitored during plankton sampling in the headpond (Locke, 1998). Brackish water

(maximum 2 PSU) was detected during plankton sampling on only two occasions, on the bottom at the station closest to the causeway. Water transparency was low, and surface temperature approached 15°C at the end of May and peaked at 24-25°C in August. The headpond falls in the meso-eutrophic category, according to nutrient levels recorded by New Brunswick Department of Environment (Locke and Klassen, *in* MWG 1998).

Headpond Vegetation

Semi-quantitative surveys conducted upstream of the causeway in 1997 revealed that *Typha latifolia* and *Juncus* spp. are widespread in the headpond and substantial beds of emergent vegetation exist upstream of the Turtle Creek headland (Hanson and Locke, *in* MWG 1998). Broad leafed arrow-leaf (*Sagittaria latifolia*) are found in conjunction with *Typha* and *Juncus* in the more protected areas and the yellow water lily (*Nuphar variegatum*) exists in calm areas in small creeks. A small colony of purple loosestrife (*Lythrum salicaria*) exists in the headpond (Hanson and Locke, *in* MWG 1998).

Pondweeds (*Potamogeton*) are the most common submerged macrophytes in the watershed. Dominant species are *(P. epihydrus) and (P. richardsoni).* Aquatic buttercup (*Ranunculus aquatilis*) is common in the Petitcodiac, North, Little, Pollett and Anagance Rivers, but was not observed in the headpond during quantitative surveys in 1997 (Hanson and Locke, *in* MWG 1998). The macroalgae *Nitella* is present but rare in most locations. Filamentous algae, sedge (*Carex* spp.) seedlings, and aquatic mosses (*Fissidens sp.*) are also present.

Benthic Invertebrates

Quantitative surveys undertaken in 1997 (Hanson and Locke, *in* MWG, 1998) revealed that littoral communities in the headpond are dominated by oligochaetes and molluscs (spherid clams and snails). Amphipods are uncommon. Insect communities represent a small portion of the biomass and are dominated by midges (chironomids), caddisflies (trichopterans) and mayflies (ephemeropterans). Only one species of mayfly, the burrowing *Hexagenia limbata* was present; shallow water and plant dwelling groups were absent. Aquatic moths (lepidopterans) and alderflies (*Sialis*) were also present. Many groups (e.g. dragonflies, damselflies biting midges) typically found in lakes or reservoirs, were rare or absent. These characteristics suggest that a community structure tolerant of periodic drying of habitat, as frequently occurs in the headpond, has developed. The sublittoral zone of the headpond was also dominated by oligochaetes and molluscs. Insects were also present with chironomids being the dominant taxon. *Hexagenia limbata* was again the only species of mayfly observed.

Only two species of freshwater mussels (*Pyganodon cataracta)* and *(Elliptio complanata*) are present in the headpond; *P. cataracta* is widespread and the age structure of its population in the headpond reflects the disturbed history of this ecosystem. No animals older than age 9 were detected, indicating that all collected animals were born after 1988 when the headpond was drawn down to its tidal state. Temporary drawdowns in 1990, 1991 and 1997 are also reflected in the population structure, but did not prevent successful reproduction of this species.

Five species of freshwater mussels were found in the Petitcodiac watershed: eastern pearl mussel (*Margaretifera margaretifera*), the eastern floater (*Pyganodon cataracta)*, the eastern elliptio (*elliptio complanata*), brook floater (*Alasmidonta varicosa*) and triangle floater wedge mussel (*A. undulata).*

Plankton

The 1997 sampling in the headpond (Locke and Klassen, *in* MWG 1998) bracketed a major drawdown (May 31-early June). Previous studies have identified flushing as a major determinant of plankton community structure in reservoirs, whereas water bodies with longer retention time harbour communities that reflect grazing pressure and food availability.

The zooplankton community in the headpond is atypical of freshwater lakes, consisting of abnormally low numbers of copepods and cladocerans for the nutrient levels, and is likely the result of repeated water level fluctuations. Many organisms are likely to be "flushed" downstream during drawdowns, followed by a recolonization of the headpond by opportunistic but competitively-inferior taxa such as rotifers. Even without irregular drawdowns, the one-way current in a reservoir or river makes it a difficult environment in which to sustain a healthy community. The plankton community in the headpond does not appear to stabilize, and consists of taxa that are of relatively poor quality as prey organisms for fish.

Rainbow smelt (*Osmerus mordax*) and gaspereau (*Alosa* spp.) larvae were collected in the headpond in May and June, albeit in much lower abundance than in other systems studied. Whether the smelt and gaspereau in the system are anadromous or landlocked is unknown. The distribution of yolk-sac larvae suggests that most of the spawning for both species occurs in the upper part of the system rather than within the headpond itself. During other work in the summer of 1997 (Hanson and Locke, 1998) observed that brown bullhead and smallmouth bass larvae and juveniles appeared to be abundant, but were not quantified.

Sampling in the headpond from July to September 1997 revealed the presence of eight species of fish. White sucker *(Catastomus commersoni)* were most abundant and both species of gaspereau *(Alosa pseudoharengus)* and *(A. aestivilis)* were captured. Brown bullhead *(Ictalurus nebulosus)* and white perch *(Morone americanus)* were abundant. Smallmouth bass (*Micropterus dolomieui*) and American eel *(Anguilla rostrata)* were less abundant and one chain pickerel *(Esox niger)* was sampled (Chaput, *in* MWG 1997). Chain pickerel, as with smallmouth bass, have been illegally introduced in the headpond. Dates of introduction and population size are not known.

2.2.2 Wildlife and Wildlife Habitat

i) Birds

Information was obtained from the volunteer-based "Survey of Migratory Birds" as well as Canadian Wildlife Service Waterbird Surveys that were conducted in 1997 and 1998.

Loons

Common loons (*Gavia immer*) use the headpond during spring, summer and fall. Both sub-adult loons (second year) and adults were observed during the pre-trial bird surveys; however, volunteers never reported observing loon courtship displays or young. During CWS water bird surveys in May, June, and early July, 1997 pairs and single common loons were observed foraging in the headpond. There is an unconfirmed report of an adult with young in the headpond during late May 1998. In New Brunswick, common loons normally only start nesting during the latter half of May, with the earliest appearance of young during the latter part of June (Erskine 1992). The breeding chronology of many species of birds were two to three weeks early in 1998 compared to previous years due to the early snow melt and mild temperatures.

Grebes

Pied-billed grebes (*Podilymbus podiceps*) were regularly sighted in the Bell Marsh area (including one brood on the marsh).

Cormorants

A few double-crested cormorants (*Phalacrocorax auritus*) were seen throughout the length of the Petitcodiac during the summer and early fall.

Waterfowl

American black ducks (*Anas rubripes*) were the most numerous species of dabbling ducks, and in some survey locations were more abundant than gulls, especially in Moncton and Dieppe just downstream from the causeway. Other species of dabbling ducks observed included mallard (*Anas platyrhynchos*), American green-winged teal (*Anas crecca caroliniensis*), blue-winged teal (*Anas discors*), ring-necked duck (*Aythya collaris*), and wood duck (*Aix sponsa*). Broods of American black ducks, mallards, American green-winged teal, blue-winged teal and ring-necked ducks were sighted above the causeway in early summer, indicating that these species nested on the shores of the headpond or in nearby marshes or impoundments.

Gulls

Gulls were the most numerous waterbirds observed during pre-trial bird surveys. Herring gulls (*Larus argentatus*) and great black-backed gulls (*Larus marinus*) were the most numerous, with

ring-billed gulls (*Larus delawarensis*) being the third most abundant gull species. This latter migratory species was present in summer and early fall only. Small numbers of Iceland gulls (*Larus glaucoides*) were occasionally present in winter (Nov.-Feb.), but were only observed downstream from the causeway.

Herons

One or two great blue herons (*Ardea herodias*) (and occasionally as many as 8-10) were usually present at survey locations downstream from the causeway during the summer and early fall. Other heron species occasionally observed included black-crowned night-herons (*Nycticorax nycticorax*) and American bitterns (*Botaurus lentiginosus*).

Shorebirds

Spotted sandpipers (*Actitis macularia*) were regularly sighted throughout the length of the Petitcodiac, both up and downstream from the causeway. In late July to September, there was a marked increase in shorebird abundance, corresponding to their southward migration and stopover in the Bay of Fundy area. Large flocks of peeps (mostly semipalmated sandpipers (*Calidris pusilla*) and semipalmated plovers (*Charadrius semipalmated*)) were noted downstream from the causeway (e.g. flock of 20,000 at Hopewell Cape in August [information from Nature NB] and a flock of 200-300 at Dieppe survey location). Substantial numbers of greater yellowlegs (*Tringa melanoleuca*) were also reported during this time period downstream from the causeway (usually 3-10 per survey, but on one occasion 160 were seen).

Hawks and Falcons

Hawk species sighted include northern harrier (*Circus cyaneus*), sharp-shinned hawk (*Accipiter striatus*) and merlin (*Falco columbarius*). (Information on peregrine falcons and bald eagles is included in the "Endangered Species" section.)

Kingfishers

Belted kingfishers (*Ceryle alcyon*) were observed both up and downstream from the causeway.

Crows

American crows (*Corvus brachyrhynchos*) were seen regularly throughout the year, but were not especially abundant (1-2 per survey).

Canada Geese

The headpond is used by several hundred Canada geese (*Branta canadensis)* at a time during the fall migration period; these feed in neighbouring farmland and return to roost on the lake as a location relatively free from disturbance and predators.

Songbirds

Red-winged blackbirds (*Agelaius phoeniceus*) were quite abundant everywhere, and other marsh songbirds were mostly seen upstream of the causeway. Species include: common yellowthroat (*Geothlypis trichas*), yellow warbler (*Dendroica petechia*), cedar waxwing (*Bombycilla cedrorum*), common grackle (*Quiscalus quiscula*), swallows: tree swallows (*Tachycineta bicolor*) and bank swallows (*Riparia riparia*) mostly, occasionally barn swallows (*Hirundo rustica*) and cliff swallows (*Hirundo pyrrhonota*); these were mostly seen in the headpond area; sparrows (song sparrow [*Melospiza melodia*], sharp-tailed sparrow [*Ammodramus caudacutus*], and savannah sparrow [*Passerculus sandwichensis*]).

ii) Furbearers

Red fox *(Vulpes vulpes)*, eastern coyote *(Canis latrans)*, American mink *(Mustela vison)*, raccoon *(Procyon lotor)*, beaver *(Castor canadensis)*, muskrat *(Ondatra zibethica)*, river otter *(Lutra canadensis)*, fisher *(Martes penanti)*, short-tailed weasel (*Mustela erminea)*, and red squirrel *(Tamiasciurus hudsonicus)* are found in the Petitcodiac watershed and the varied habitats therein (ADI & Washburn & Gillis, 1992). Most of these species are either absent or found in low numbers in the immediate area of the headpond.

Few muskrats, and very little muskrat sign (houses, runs, feeding platforms) were observed in the headpond area during the course of CWS waterbird surveys or DFO surveys for aquatic macrophytes. High quality muskrat habitat is characterized by abundant emergent vegetation (*Typha spp., Scirpus*) and stable water levels. Within the headpond area, emergent vegetation is limited to shoreline bands located primarily along the river between Allison Station and Boundary Creek. Because of the large watershed and limited opportunity to discharge water at the causeway, the water level on the headpond fluctuates greatly. In contrast to the headpond itself, numerous muskrats are found in the Bell's Marsh impoundment, which has stable water levels and extensive stands of cattail.

DFO staff observed only one old beaver dam during their surveys of streams flowing into the Petitcodiac River. No beaver or beaver sign were observed in the headpond. This may be due to a combination of inadequate food resources, shallow water depths, and an inability to impound water (M. Hanson, *pers. Comm.*).

2.2.3 Endangered Species

The Peregrine Falcon (*Falco peregrinus anatum*) is listed as endangered by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) and is protected under the New Brunswick Endangered Species Act and Regulations. A pair of Peregrine Falcons is known to nest on a cliff along the Petitcodiac River, more than 30 km downstream of the causeway. Another pair of Peregrine Falcons nests on a cliff along Shepody Bay more than 60 km downstream of the causeway. These birds are known to prey on forest birds at the beginning of the breeding season, and to switch to shorebirds later on in the summer.

The Bald Eagle (*Haliaeetus leucocephalus*) is protected under the New Brunswick Endangered Species Act and Regulations. Bald Eagles were observed regularly both above and downstream of the Petitcodiac River causeway during pre-trial volunteer bird surveys. Bald Eagles are known to forage and nest in freshwater, brackish, and marine habitats. There is an active bald eagle nest on the north side of the Petitcodiac headpond. The area surrounding the bald eagle nest is currently being developed as a housing subdivision. As of November 1998, one house was completed and a housing lot next to the bald eagle nest was being cleared. The New Brunswick Department of Natural Resources and Energy (NBDNRE) has developed protocols with the developer to minimize the impact of the development on the nesting site. This eagle nest fledged three young in 1998 (A. Hanson, pers. obs.) and three young in 1997 (J. Edsall, pers. comm.).

The Petitcodiac River was the only known Canadian location of the endangered (US listing) dwarf wedgemussel *(A. heterodon)* prior to construction of the causeway in 1968. The species was not detected during surveys in 1984,1997 and 1998 suggesting its extirpation as a result of the causeway construction. This could potentially result from the lack of a suitable fish host species following the diminishment of anadromous fish runs.(Hanson and Locke, *in* MWG 1998). The species does not appear on the COSEWIC listing; but a report, recommending that the species be declared extirpated from Canada, is currently under review by COSEWIC.

The brook floater (*A. varicosa*), a freshwater mussel, is found in the lower portions of Little (Coverdale) River and in the main Petitcodiac River between Petitcodiac and Salisbury. This species is considered "threatened" on US listings.

The eastern pearl mussel (*Margaretifera margaretifera*) is a species of special concern (US listing) because of the current decline of its fish host species, the Atlantic salmon (*Salmo salar*), which in turn has been particularly affected by causeway construction. It is common throughout much of the watershed.

2.2.4 Wetlands

Downstream of the causeway, the Petitcodiac River is bordered by salt marshes and mudflats. Similar habitat would have been present above the causeway, prior to the dyking and draining that occurred during agricultural development. The construction of the causeway and the creation of the headpond resulted in additional destruction of salt marsh upstream of the causeway. Limited freshwater marsh habitat has developed along the edges of the headpond and streams entering the headpond. The headpond can be characterized as deep marsh and open-water classes of wetland habitat (Hanson and Calkins 1996). The lack of submergent vegetation in the headpond make it a relatively unproductive habitat for diving ducks such as lesser scaup and ring-necked ducks (Hanson and Locke 1998, A. Hanson, *pers. obs.*).

Warm damp weather coupled with the advent of high tides within the marsh (areas) provide excellent breeding conditions for biting insects. (Greater Moncton Pest Control Commission - 1997 Annual Report.) The same report identifies most of the mosquito breeding areas in marshes as being downstream of the causeway. It also concludes that the densest mosquito larvae populations would most likely occur in marshy areas and abandoned agricultural lands. Although

potential mosquito breeding habitats could be found throughout the Greater Moncton study area, the area near Bell's Marsh, which contains large surfaces of abandoned agricultural lands where small marshes have developed, was deemed to be the most favourable.

2.2.5 Sediments

i) Estuary

The Petitcodiac estuary, like other upper Bay of Fundy estuaries, is subject to unstable interactions between sea level and soil. Chignecto Bay is a high-energy environment, exhibiting strong currents that are eroding previously-deposited muddy sediments and mudstone cliffs in the outer part of the Bay. Sediment input from these sources is about 6×10^6 m^3y^{-1} and 1.0×10^6 m^3 y^{-1} respectively, whereas fluvial input is low in comparison (0.3×10^6 m^3y^{-1}, or 4% of total sediment volume mobilized each year). Chignecto Bay is a well-mixed seaward exporter of sediments and is devoid of major sinks of fine-grained sediments. Material is kept in suspension until it reaches the deeper part of the Bay of Fundy.

There are large seasonal variations in suspended particulate matter (SPM) in Shepody/Chignecto Bay, with peak values recorded during ice break-up. Summer values decrease steadily due to deposition on littoral mudflats, and increase again in the fall because of wave-induced resuspension. SPM values can vary by an order of magnitude over distances of a few km and within hours at the same location (Schell, *in* MWG 1998).

Suspended sediment concentrations recorded at three sites along the Petitcodiac River in fall 1997 were strongly modulated by tidal action downstream of the causeway, and by wind and runoff just upstream of the structure (St-Hilaire *et al*, *in* MWG 1998).

ii) Sedimentation Upstream of Causeway from Saltwater Intrusion

During low headpond water level conditions accompanied with high tide, salt water intrudes in the headpond through the fishway and around the gates. Mud accumulates in the first 500 m of the headpond, upstream of the causeway gates. Observations in 1998 revealed that mud accumulation near the causeway gates reached elevations 4.5 to 5.0 m.

iii) Erosion Immediately Upstream of the Causeway

When mud flushing through water spilling is done during high river flow conditions, erosion of the channel immediately upstream of the causeway occurs. This required mud management results in a scouring of the river channel upstream of the causeway to as low as 1.5 m below the gate concrete floor. This also results in erosion of the first 300 to 500 m of shoreline upstream of the causeway on the Riverview side.

iv) Sedimentation Downstream of the Causeway

Under the present gate management scenario mud infilling of the Petitcodiac River occurs downstream of the causeway during extended low freshwater flow conditions. Sediment laden salt water moving in with the tide deposits its material during conditions of still and slow moving water. If there is sufficient fresh water input during the receding tide, this sediment is resuspended and transported downstream.

The June 1998 flushing effort confirmed the sediment accumulation which occurs in the river channel downstream of the causeway. After the initial flushing, silt began to accumulate in the channel at rates occasionally exceeding 0.1m per day.

v) Erosion Downstream of the Causeway

Erosion downstream of the causeway occurs during large freshwater flow conditions. Survey information collected in 1979, 1986, 1988, 1991, 1997, and 1998 shows silt and mud accumulate during low freshwater flow periods and erodes during high freshwater flows.

Opening the gates with surface water elevation of the headpond higher than the tide releases erosive energy immediately downstream of the causeway. Erosion further away from the causeway is more a result of outflow volume rather than the difference in head.

2.2.6 Water and Sediment Quality

i) Water

Marine waters of the upper Bay of Fundy, and Shepody bay are nutrient rich, especially with regard to phosphorous. The outfall of the Greater Moncton Sewerage Commission is located approximately 5 km downstream of the causeway gates. Water samples collected at the Gunningsville Bridge indicate that faecal coliform bacteria levels are above the recreational contact level of 200 counts/100 mL and often above the recreational boating guideline of 5000 counts/100 mL. Water quality sampling done off the Gunningsville Bridge in October 1997 indicated Faecal Coliform counts ranged from a low of 2700 c/100 mL at low tide to as high as 33,200 c/100 mL at the beginning of rising tide.

In 1998, water quality samples were taken off the Gunningsville Bridge on November 25 and 26. On November 25, faecal coliform sampling was done with a temporary holding of the Greater Moncton sewerage treatment plant effluents at the beginning of rising tide. Faecal coliform counts ranged from 3000 c/100 mL before the tidal bore to as high as 20,000 c/100 mL as the tide moved in. One causeway gate was open at the beginning of the sampling and closed as the tide started moving in. On November 26, 2 causeway gates were open and freshwater input was significantly higher. This had the effect of drowning out the rising tide and resulted in faecal coliform levels consistently below 3000 c/100 mL from low tide to high tide.

Water samples collected from the headpond in 1997 indicate that faecal coliform counts are for the most part below the contact recreation guideline of 200 cells/100 mL and are all below the recreational boating guidelines of 5000/cells/100 mL. The values present in the headpond are attributed to land use and are not related to salt water intrusion (except in the immediate area of the fishway).

Nine water samples were collected from the Petitcodiac River and headpond on July 16, 1998. All samples were tested with the Microtox Toxicity Assessment System using the Microtox 100 % Test Protocol, and all samples were not acutely toxic. Effects on bioluminescence ranged from 3 to 17% decrease from the control. (Jackman and Doe 1998).

Twenty-six (26) water samples were collected from the Petitcodiac River at the Gunningsville Bridge and headpond in July, October, and November, 1997. All samples were tested with the Microtox Toxicity Assessment System using the Microtox 100 % Test Protocol. All samples were non-toxic with calculated EC-50's greater than 90% sample. Effects on bioluminescence ranged from slight stimulation to slight decrease (Jackman and Doe 1997).

There are no public swimming beaches on the headpond, but there are at least two boat launch areas, one at the causeway near the gate structure and a second with a concrete pad near the Riverview Kinsmen Centre. A third area at the Moncton end of the causeway is used by recreational wind surfers, kayakers, and sea cadets. Several private boat docks are located behind private property on the headpond and swimming activity has been observed from one of these private docks.

4) Sediment Quality

Three sediment samples and one composite sample of suspended sediment were collected from the Gunningsville Bridge area on September 3, 1997. The suspended sediment sample was allowed to settle at 4°C for 24 hours. The overlying water was removed and the remaining sample analyzed as suspended sediment. These samples were tested for toxicity in the Microtox Solid Phase Test. None of the samples were considered toxic. Additionally these samples were tested for toxicity using a 10-day test with inlaund estuarine amphipods (*Eohaustorius estuarius*). None of the samples were toxic to the amphipods (Jackman and Doe 1997).

Six sediment samples were collected from the Headpond and River on June 2, 1998. These samples were tested for toxicity in the Microtox Solid Phase Test. None of the samples were considered toxic. These samples were also tested for toxicity using a 14-day growth and survival test with the freshwater amphipods (*Hyalella azteca*). None of the samples were toxic to the amphipods. (Jackman and Doe 1998).

3.8.7 Air Quality

Air quality in Moncton, as measured hourly since July 1998 by a New Brunswick Department of Environment (NBDOE) Air Quality station located on Highfield Street, was categorized as being "Good" 99.6% of the time, based on preliminary, yet to be validated data. The Air Quality station measures the following parameters: nitrogen dioxide, ground level ozone, and carbon monoxide. "Fair" conditions, lasting only a few hours, were reported for at least one of the above parameters in August and September. There is consideration currently being given to monitoring of suspended particulate matter.

Two air quality parameters that could potentially raise concern during the trial are dust resulting from and odours emanating from the exposed mudflats as a result of the headpond drawdown. (See section 3.7)

3.9 SOCIO-ECONOMIC SETTING

Valued Environmental Components

3.9.1 Consumptive Resource Use

Consumptive resource use within the study area includes recreational fisheries, commercial fisheries, native food fisheries, and furbearer and waterfowl harvesting. For purposes of analysis, consumptive resource use can be discussed in terms of two categories, fisheries and wildlife. Fisheries consumptive resources include fisheries associated with river and flood plain ecosystems. Wildlife consumptive resources include furbearers and waterfowl.

i) **Fisheries Resources**

ii) **Recreational Fisheries**

Atlantic salmon had been the principal sport fish on the Petitcodiac River prior to completion of the causeway in 1968. Both bright spawning fall and black salmon (kelts) were angled from its waters. The majority of the catch was taken from the main Petitcodiac and the Little (Coverdale) River. Demoiselle Creek and Pollett River produced smaller catches. Statistics collected since 1951 show a wide fluctuation in catch, but the largest was in 1967 when 800 bright salmon and 442 black salmon were captured. Recreational catches declined dramatically following causeway completion, one year later in 1968. Catches ranged from 0 to 43 salmon between 1968 and 1982, with no captures beyond that time.

Prior to causeway construction, there was increasing recreational interest in shad angling during May and June between Moncton and Salisbury, but this interest waned after causeway construction due to low numbers of shad passing the structure.

A recreational fishery for sea run trout now occurred on the Newcastle River, but there is a general lack of angling records for this species. An increase in sea run trout redd upstream of the causeway in 1999 coincided with an early going opening of the causeway gate that year. There is also a recreational fishery for resident (non anadromous) brook trout which are generally distributed throughout the tributaries of the watershed and in the headpond.

Smallmouth bass have been introduced to the headpond which has resulted in a small recreational fishery in localized areas of the impoundment. There are no official catch records.

A small angling fishery for striped bass has now occurred upstream of the causeway, but catches have been low.

Prior to 1968, a recreational dip net fishery for smelt occurred in the Salisbury area, but this fishery ceased to exist after causeway construction. Some dip-netting for smelt still occurs downstream of the causeway.

b) Commercial Fisheries

Historical records show that species of commercial interest in the Newcastle River basin included Atlantic salmon, shad, rainbow smelt, American eel, brook trout, gaspereau, striped bass, tomcod, sturgeon, herring and eel. A limited recreational fishery was undertaken by Aboriginal people, followed by a more concentrated exploitation of the resource by Acadians in the eighteenth century. By 1760, most of the Newcastle River basin was settled and its fishery resources were being utilized.

Atlantic Salmon

Salmon were heavily fished by a variety of methods from the earliest times of settlement and salmon catches of 150,000 pounds have been reported from the early 19th century. Overfishing and habitat degradation by the lumber industry required the implementation of strict conservation measures to protect the resource. Commercial catch statistics from 1873 until the imposition of a fishing ban in 1971 indicate consistently wide fluctuations in annual catches. Since the 1930's, catches rarely exceeded 5,000 pounds, averaging 1,100 pounds annually. By the 1950's, the commercial salmon catch was entirely from the drift net fishery for shad and salmon. By 1967, the year before completion of construction of the causeway, there were approximately 10 boats licensed to catch salmon and/or shad, which fished mostly from the Chatham Bay area. This proved to be the last year for salmon drift net fishing since the 1930's and may reflect a build-up of salmon due to causeway construction during the period. After closure of the salmon fishery in 1971, incidental captures were still made in shad drift nets, though incidental captures were discontinued after 1983.

Shad

The commercial fishery for shad is concentrated in the Grand Chatham Bay area and exploits mixed stocks originating from rivers all along the Atlantic Coast (Dadswell et al., 1987). Catches

sea harvest, we could welcome a Nantcoddy River production. Until the mid-1860's, deep-sea capture in cove and sounding sea, drift or fishing commenced in Seagull Bay around 1800 and by 1850 about 50 deep-boat cove fishing Seagull Bay and its inner Nantcoddy estuary. In 1870, 850,000 pounds of deep cove taken from the general area. By 1915 it cove and 2, more had taken 10,000 pounds of deep and 2,000 pounds cove taken by fishing one. By 1975, there was a small commercial fishery involving 9 licensed deep drift net, other cove taking approximately 25,000 pounds annually from River to Seagull Bay. Six thousand (6,000) pounds of deep cove landed in 1990.

Lamprey

The only cove of the lamprey fishery on the Nantcoddy River we provide documented in between 1869 and 1873, when a mill formation from an Mont County 1880 of 1 million pounds in 1869 to 35,000 pounds in 1873. Average landings during the cove 1900-1907 and 1988-1977 were 1,000 and 5,000 pounds, respectively. Ten thousand (10,000) pounds cove captured in 1990 and 15,000 pounds in 1996.

Rainbow Smelt

A traditional smelt fishery had been carried on in the Salisbury area mill ponds in the spring, but the fishery has been severely depleted since completion of the causeway. Commercial records show the in 1870, 350,000 pounds were taken in the entire Nantcoddy fishery. Five thousand (5,000) pounds were landed in the Nantcoddy fishery in 1975. No commercial fishery exists for the species in the present era.

Striped Bass

Statistical records show occasional catches of striped bass in the commercial fishery of the Nantcoddy system. Twelve hundred (1,200) pounds were reported taken in 1870 and 10,000 pounds taken in 1910. There is currently no commercial fishery for the species.

Brook Trout (Sea Run)

Historical records support the theory that significant runs of brook trout occurred in the river in the Nantcoddy River. Thirteen thousand five hundred (13,500) pounds were captured in the Nantcoddy estuary in 1870, and similar catches were made in 1915 and 1940. There is currently no commercial fishery for the species.

American Eel

As many as 80,000 pounds of eels were taken annually in the commercial fishery at the time of Confederation and annual catches of 10,000 pounds were still being made after 1915. Commercial interest in the species has declined by the 1950's, and by 1970 the commercial fishery was near closure. Eel pots and traps are used in the fishery, which landed a total of 6,000 pounds in 1990 in the Nantcoddy estuary. A small licensed river fishery exists

immediately downstream of the causeway and a minor eel fishery upstream of the causeway is occasionally prosecuted.

Sturgeon

Statistical records for 1913, 1914 and 1929 show sturgeon catches of 5,800, 6,000 and 3,300 pounds, respectively, reported for the Petitcodiac system. Annual catches of approximately one metric tonne were reported until the 1980's when catches began to fluctuate from 0 to 8 metric tonnes.

Lobster

The interpretation of fishery statistics for lobster in the upper Bay of Fundy is complicated by three factors: 1) the lack of information on fishing effort for a given catch record, 2) a major change in 1996 in the reporting system (from lobster buyers previously sending sales slips, to catch settlements now being submitted by the fishermen); and 3) improved fishing efficiency over the past decade, including a switch from wooden traps to wire traps, and better locating equipment, boats, and night-fishing capabilities (Lawton and Robichaud, in MWG, 1998).

Bearing the above in mind, landings for the Chignecto Bay area have increased, and in particular those of Alma and Wood Point (statistical districts 79 and 81), since the early 1990's. Improved catches parallel [illegible] ster catches in Nova Scotia and Gulf of Maine, and the increased lobster production in the Bay of Fundy generally. The fishermen also report an increase in the areal extent of lobster grounds in the upper Bay, and a concurrent reduction in fine sediments on the bottom.

Scallop

There are 31 active scallop licenses in the Upper Bay of Fundy (which, geographically, includes Minas Basin as well as Chignecto and Shepody Bays, and Cumberland Basin). Upper Bay of Fundy landings have declined in recent years, from a peak of 91 tonnes in 1990 to 12 tonnes in 1997 (Kenchington et al., in MWG, 1998). Their landed value has also declined from its peak of $820,000 in 1990 to $224,000 in 1997. Strong 1985 and 1986 year classes settled throughout the Bay of Fundy, including the upper reaches and previously low-density grounds of the bay, but recruitment has been poor since the 1985-86 year classes entered the fishery.

c) **Aboriginal Fisheries**

Aboriginal peoples living in the area of the Petitcodiac watershed have, in the past, used the river system extensively for fishing. In the 1940's and 1950's, the fish were plentiful and catches included Atlantic salmon, trout, shad, gaspereau, and tomcod. Presently, tomcod and gaspereau are the most popular catches for Aboriginal people fishing in the Petitcodiac River system (J. Knockwood, pers. comm.). These are caught downstream of the causeway close to Dorchester.

The Fort Folly First Nation is presently considering obtaining a commercial fishing license to harvest both lobster and shad in an area downstream of the causeway.

ii) Wildlife Resources

According to 1996-97 statistics obtained from the Department of Natural Resources and Energy, Fish and Wildlife Branch, there were 21 fur harvester licenses purchased at the DNRE Ranger offices in Moncton and Petitcodiac.

A fur harvesters license entitles the holder to:

- hunt bobcat, fox, skunk, raccoon, coyote, squirrel or rabbit;
- trap beaver, bobcat, coyote, fisher, fox, marten, mink, muskrat, otter, rabbit, raccoon, skunk, squirrel, or weasel; and
- snare beaver, bobcat, coyote, fox, otter or rabbit.

Although license holders are not required to harvest in the area in which the license was purchased, it is reasonable to assume that most of the license holders do (G Lawlor, pers. comm.). A local trapper reports that three or so people trap the headpond and associated tributaries and they harvest a limited number of muskrats and a few mink. An earlier report estimated there to be six trappers who harvest muskrat in the headpond area, with no beaver harvested (ADI and Washburn & Gillis 1992).

Members of the Fort Folly First Nation harvest various waterfowl at locations downstream of the causeway (J. Knockwood, pers. comm.) in the Dorchester area.

There are numerous locations downstream of the causeway where waterfowl are harvested by the general public.

Within the headpond itself, there is some hunting of waterfowl in the Allison Station section of the river. There is limited hunting opportunity on the headpond because of municipal bylaws which forbid the discharge of firearms and the Provincial Fish and Wildlife Act which forbids the discharge of a firearm within 200 m of an occupied dwelling. During CWS waterbird surveys in October 1998, five hunting blinds were observed.

2.3.2 Recreation/Tourism

i) Recreation

The recreational activities taking place in the vicinity of Petitcodiac causeway are generally outdoor activities and are, therefore, seasonal in nature. The trial gate opening is expected to begin in April, 1999 and be completed before the end of November 1999, therefore, the analysis will be confined to summer and fall recreational activities.

The recreational activities and facilities in the study area primarily serve residents of the Greater Moncton Area (Moncton, Riverview, and Dieppe). The socioeconomic boundaries for recreation include the life of the project and extend throughout the Greater Moncton Area.

Several water-based recreational activities take place upstream of the causeway on the headpond. These activities include boating, sailing, windsurfing, canoeing, kayaking, water-skiing. These activities are partaken primarily by local residents. There is a boat launch on the waters edge by the Riverview Kinsmen Community Centre. Canoes and kayaks are put into the water from the boat launch area and the river bank. Recreational swimming has been observed from private docks.

There was a tour boat operation which used the headpond area in 1995 and 1996, however, it ceased commercial operation in 1997.

The Coverdale Sea Cadets use the headpond for sailing lessons during May, June, September, and October.

Snowmobilers use the headpond as a crossing during winter months when the headpond is safe to cross. There is a planned Snowmobile festival which would use the frozen headpond in the winter of 1999-2000.

The City of Moncton maintains two recreational parks adjacent to the Petitcodiac River downstream from the causeway (R. Landry, pers. comm.). No water-based recreational activities take place from either of the parks.

The Sportsplex, located between Waterloo, Foundry, and Bridge Streets is primarily an adult recreational park with 4 softball fields, a soccer field, and lounge which seats 400-500 persons. There is a Riverwalk that extends from the Gunningsville Bridge, passes through the Sportsplex and Bore Park, and terminates close to the Moncton/Dieppe border.

The second recreational park maintained by the City of Moncton is Bore Park which is located on Main Street near Duke Street. It is a passive park which is centred around the explanation and interpretation of the tidal bore. Students are employed during the summer months by the City of Moncton as information officers, distributing tidal bore and other tourism information.

On the south (Riverview) side of the Petitcodiac causeway, there are three riverfront recreational parks maintained by the Town of Riverview (K. Edson, pers. comm.). These are Fox Field, Riverfront Park, and Harold Page Field. No water-based recreational activities take place from any of these locations.

Fox Field is an adult ball field. Riverfront Park is a passive park with shrubbery and trees. Groomed tailings walking trails are located on the water's edge and are extensively used by local residents. Harold Page Field is the only lighted ball field in Riverview which caters to both adult and minor leagues. Clay tennis courts have been recently added to the property.

Bird-watching takes place as a recreational activity within the study boundaries. Birds that were sighted during the baseline monitoring activities included common loons, pied-billed grebes, cormorants, herons, hawks, falcons, kingfishers, crows and a variety of shorebirds and marsh songbirds.

ii) Tourism

Tourism is an important component of the Moncton economy. People visit the Moncton area from within New Brunswick, other Canadian provinces, United States, and other parts of the world. The socioeconomic boundaries for tourism include the life of the trial gate opening project and extend to all potential visitors.

The two most important natural attractions in the Moncton area have been said to be Magnetic Hill and the tidal bore of the Petitcodiac River. The tidal bore is a unique phenomenon which is reported to occur in only four other rivers in the world (Fitzpatrick, 1994). Since construction of the causeway, there has been a noticeable reduction in the amplitude of the tidal bore. However, in a report completed in 1994, it was noted that the reduction in size of the tidal bore has not detracted from its status as an important tourist attraction. It is apparently the phenomenon that is important as opposed to the actual size of the bore (Fitzpatrick, 1994). Nevertheless, many local residents consider the phenomenon to be far less than spectacular, and it has fallen short of expectations for many tourists and local residents alike.

A new hotel, "Chateau Moncton", is being built near the mouth of Hall's Creek along the bank of the Petitcodiac River. The location of the hotel suggests it will promote a view of the tidal bore as one of its assets.

2.3.3 Land Use and Development

The immediate noticeable effect of the project will be the drawing down of the headpond below the 2.5 m level, resulting in the visibility of mudflats. The spatial boundaries will reach from the Petitcodiac River causeway to beyond the mouth of the Turtle Creek where the headpond essentially narrows to a river. The temporal boundaries are limited to the project period (April-November, 1999).

Land use on the upstream side of the causeway to Turtle Creek includes a mix of residential, commercial, recreational, and agricultural use. The majority of the development on the south side of the causeway has taken place in the last ten years.

i) Residential Land Use and Development

It is evident from the orientation of the structures, that the vast majority of houses, apartment complexes, townhouses, and condominiums have been situated to take advantage of the view of the headpond and its surrounding environment.

Most of the older residential properties located on the north side of the causeway and bordering the water have trees or hedging which appear to obstruct the view of the headpond. Most of the newer residential properties that border the water have no view obstructions.

In 1998, there were approximately 52 residential properties listed for sale in the headpond area 12 on the Coverdale Road side and 40 on the Salisbury Road side. Prices ranged from $40,000 to $349,000 (information obtained from Century 21-Countryside Realty, Riverview, NB). The real estate market in Moncton was characterized as a buyers market.

ii) Recreational Land Use and Development

The Riverview Kinsmen Community Center is located on property which abuts the headpond. The Kinsmen and the Town of Riverview have plans and financial support to construct a marina, bathing beach, boat launch, picnic/BBQ park and walking trails at this location.

iii) Agricultural Land Use and Development

There are approximately 12 farms located on the lake portion of the impoundment (approximately 10 kilometres upstream from the causeway). The principal type of farming is dairy with secondary hog raising. The total area of farmland is 320 acres which includes 80 acres of pastureland that has been reclaimed from marshland. A system of dykes protected 60 acres of marshland prior to the construction of the causeway. An additional 20 acres was reclaimed as a result of the causeway.

When the causeway gates were opened for four months in 1988, no effects such as tidal flooding were experienced (Fitzpatrick, 1994). Large volumes of silt were deposited by the tides in the vicinity of at least one of the farms when the gates were opened; however, this farm owner viewed the accretion positively as potential to reclaim more land (Fitzpatrick, 1994). It is important to note that the gates were not open in 1988 during periods when the highest tides occurred.

3. POTENTIAL ENVIRONMENTAL EFFECTS

Biophysical Effects

Environmental Effect Significance Criteria

In determining the significance of a potentially adverse biophysical environmental effect, the following Environmental Effect Significance Criteria have been applied:

- magnitude of the adverse environmental effect;
- geographic extent of the adverse environmental effect;
- duration and frequency of the adverse environmental affect;
- degree to which the adverse environmental effects are reversible or irreversible.

3.1 Fish and Fish Habitat

i) Fish Passage

Upstream fish passage at the Petitcodiac causeway has been inefficient for all anadromous fish species. Downstream fish passage has also been inefficient for Atlantic salmon in particular. This is due in part to the design of the existing fishway and to the unique river conditions in the tailrace of the causeway involving the rise and fall of the tides. The problem is compounded by the wide variation in the requirements of the target species for fish passage under these conditions. Numerous attempts to improve fish passage through modifications to the fishway and the causeway gates have failed (Ritter, 1991). Similar problems exist on other nearby rivers where flows are regulated by vertical-lift tidal gates (i.e. Shepody River, Memramcook River).

It is expected that during the trial gate opening, upstream fish passage efficiency will be considerably improved by allowing upstream migrating fish to periodically utilize the free flow of the river at each tide. Upstream passage of Atlantic salmon, sea trout, shad, smelt, gaspereau, striped bass and American eels is expected to improve during the project. Downstream passage will also be considerably more efficient for Atlantic salmon smolts which, in turn, should increase numbers of adult salmon returns to the Petitcodiac River. A high adult return of salmon in 1983 coincided with a drawdown of the headpond in 1982, thereby allowing salmon smolts to successfully pass the causeway that year. Other species, including smelt, are also likely to benefit from improved downstream passage. Adequate freshwater spawning and rearing habitat is available to successful upstream migrants of all species as the river habitat is currently underutilized. The trial gate opening is expected to have a significant positive effect on anadromous and catadromous fish species.

ii) Fish Habitat

a) Headpond

Freshwater fish species (suckers, bullheads, white perch, smallmouth bass) currently inhabiting the headpond will be displaced upon drawdown and are expected to seek habitat upstream on the main river and tributaries. Colonization of new habitats by former headpond inhabitants is unlikely to significantly increase competition as most of the freshwater habitat upstream of the causeway is currently underutilized. It is expected that, upon completion of the experiment, opportunistic freshwater fish species, similar to the community which inhabited the headpond prior to the trial gate opening will re-colonize the refilled headpond. The residual effect on the headpond fish community is considered to be not significant.

The trial gate opening is expected to eliminate a high percentage of freshwater mussels in the headpond, but they will quickly re-colonize when it is refilled upon completion of the trial. Mortality and re-colonization is a common occurrence in habitats of fluctuating water level. *P. cataracta* and its larval host species occur throughout the watershed so the species will not be eliminated. The proposed experiment will have no significant effect on the remainder of the

benthic macroinvertebrate community in the headpond, which is currently recovering from five major disturbances since 1988 (Hanson and Locke, *in* MWG, 1998).

The planned trial gate opening is not expected to have a significant effect on emergent vegetation in the headpond due to the limited time frame of the trial gate opening. Most emergent plants can tolerate fluctuating water levels and drought conditions for several growing seasons. It would take several years for plant succession to take place in response to altered hydrology.

There will also be a minimal effect on submergent macrophytes, many of which will enter a dormant state during the dry period. Although some will be killed by the drawdown, these are expected to quickly re-colonize the headpond upon refilling. The effects of the trial gate opening, therefore, on headpond aquatic vegetation are considered to be not significant.

Planktonic organisms are carried by currents. Generating a temporary estuarine environment upstream of the causeway will favour estuarine taxa of zoo- and ichthyoplankton, which have evolved behavioral mechanisms that take advantage of tidal cycles to maintain or change their longitudinal position in the estuary. An estuarine environment can, therefore, be expected to improve the health of the plankton community and be more conducive to early larval development. A positive environmental effect is expected.

b) Downstream of Causeway

It is unlikely that a correlation between improved lobster landings or habitat in the upper Bay of Fundy and the existence of the Petitcodiac causeway can be conclusively demonstrated. Furthermore, even if such a correlation were confirmed, the cause of the improvements to the fishery would be virtually impossible to identify because of the other factors that have varied or changed concurrently with the advent of the causeway and subsequent increases in the catches.

Notwithstanding the above, monitoring activities will be expanded in the Chignecto Bay area during the trial gate opening, to compare the lobster fisheries before and during the trial opening and to address fishermen's concerns. However, the trial gate opening is not expected to result in a measurable effect on lobster because sediment patterns in the upper bay are not expected to display a measurable change as a result of the opening of the causeway gate(s) (see sediment patterns).

The potential effect of the gate opening project on fish habitat downstream of the causeway is considered to be not significant as no adverse effects on water quality, sediment quality or sediments are anticipated.

3.2 Wildlife and Wildlife Habitat

i) Birds

The present headpond appears to have increased local bird diversity by providing an area of open freshwater near adjacent fresh and saltwater marsh areas. Breeding waterfowl, swallows and

migrating waterfowl, which are attracted by the freshwater, will likely occur in lower numbers during the trial opening of the causeway gates. Waterfowl adapt to annual changes in habitat conditions and, as a consequence, any displaced waterfowl will likely adapt to the absence of freshwater and breed elsewhere in 1999. Several species, such as black ducks, green-winged teal and mallard, would likely continue to nest in adjacent marshy areas where creeks enter the Petitcodiac system. Others may move to the Bell Marsh Ducks Unlimited impoundment which is adjacent to the headpond. This wetland consists of a flooded dyked impoundment with a water control structure and is not expected to be affected by the trial gate opening. Due to the adaptability of waterfowl species found in the headpond, the project is not expected to result in long-term significant negative impacts on regional waterfowl populations.

Refilling of the headpond will have little effect on nesting waterfowl. There is very little nesting cover below the current water level so very few nests (if any) would be built in areas which would be flooded when the headpond is refilled. .

No courtship displays of common loons or chicks were reported by volunteers or CWS staff during pre-trial bird monitoring. There have been reports of an adult common loon with young having been seen in headpond. However, since common loons in New Brunswick normally only start nesting during the latter half of May, lowering of the water level before this date would be prior to nest initiation. Any loons that may have nested on the headpond previously would go elsewhere.

Once the headpond has been drained, it will likely be less attractive to roosting Canada geese. In the spring Canada geese spend very little time in the headpond area, but spend considerably more time there during their fall migration. The headpond is likely to be refilled before considerable numbers of Canada geese arrive in the fall of 1999. Also it should be noted that the headpond is not critical habitat. Canada geese can use alternate roosting sites if the headpond is not available. Canada geese are numerous along the Petitcodiac River near Lower Coverdale, where there is no headpond. Canada geese may also choose to roost on tidal waters such as Shepody Bay if the headpond is unavailable. Canada geese in the Tantramar region roost on Cumberland Basin. There should not be any overall significant impact of the trial gate opening on migrating Canada geese.

The trial gate opening is not anticipated to have a significant effect on other bird species, such as ospreys, gulls, hawks, crows and songbirds which were recorded above and below the causeway. Several species that utilize brackish estuarine habitats, including bald eagles, great blue herons, double-crested cormorants, and black ducks, might occur more frequently. Estuarine habitats remain ice-free for a longer period of the year although the headpond will be refilled with freshwater late in the year.

ii) Furbearers

According to ADI Limited and Washburn & Gillis Associates Ltd. (1992), "Under the current conditions, furbearer production and harvest in the natural headpond marshes is low". In the short-term, the headpond muskrats may experience negative effects if water levels drop

dramatically in their territories. In terms of local populations, this effect would be minimal because of the limited numbers of muskrats in the headpond and the large muskrat population in Bell's Marsh. No long-term effect on the regional muskrat population would be anticipated. Muskrat populations are often cyclical and muskrats have evolved mechanisms to exploit new habitats quickly. Muskrats are prolific and can have up to three litters of six young per year, which are forced to leave their natal territories and disperse to new habitats. (T. Pettigrew, Pers. comm.)

Species such as red foxes, eastern coyotes, and raccoons are adaptable and found in a variety of habitats. Their populations would not be expected to suffer significant adverse effects due to the trial gate opening.

Overall, the potential environmental effect of the trial gate opening on furbearers is considered to be not significant.

3.3 Endangered Species

The trial gate opening is not expected to have any significant effect on the dwarf wedge mussel, *Alasmidonta heterodon*, if in fact, it is present in the watershed. The experiment is not expected to affect water quality or the presence or absence of larval host species. If *A. heterodon* has indeed been extirpated, as is being deliberated by COSEWIC, its potential re-establishment in the watershed through re-colonization of its presently unknown host is unlikely, given the short duration of the experiment (Hanson and Locke, *in* MWG,1998).

Similarly, potential effects of the trial gate opening project on *A. varicosa* and *Margaretifera margaretifera* are considered to be not significant as water quality and the presence/absence of larval host species are not affected.

The potential effect of the trial gate opening on peregrine falcons (*Falco peregrinus anatum*) is considered to be not significant.

Bald eagles (*Haliaeetus leucocephalus*) are known to forage in both the marine and freshwater sections of the river. The trial gate opening is not expected to significantly decrease food availability. There are numerous tributaries to the river, which would be little impacted by the trial gate opening. Bald eagles are highly opportunistic scavengers and adapt to changes in their environment as long as there are sources of food available. The bald eagles that have previously nested along the headpond may not return to their nesting site in 1999 due to the potential disruption caused by the housing development. Overall, the potential effect of the trial gate opening on bald eagles is considered to be not significant.

3.4 Wetlands

i) Upstream of Causeway

Over the short-term, there will likely be some loss of emergent vegetation above the causeway, resulting in the loss of some freshwater wetland habitat in this area. If this were a long-term project, with water levels maintained over the long-term, succession would see the replacement of the current wetland habitat with a wetland adapted to the new hydrological regime. However, it is uncertain which type of plant community will develop in the short-term, if any. Exposure of the mudflats during summer is an ideal condition for germination of species that may be present in the seedbank or watershed, including Cattail and Beggar's Tick.

The time required for a salt marsh to develop is much greater than the duration of the trial gate opening. The concern of some residents regarding a potential increase in mosquito populations, due to salt marsh creation, should not materialize. There may be temporary additional mosquito breeding potential in the wetted isolated mud flat depressions that will appear as a result of the headpond drawdown. However, as the mudflats dry up, breeding area would be reduced. At present, there is extensive mosquito habitat along the Petitcodiac River. As a result the Greater Moncton Pest Control commission (GMPC) has been set up to study the matter and control options. The 1998 Annual Report of the GMPC indicates it will monitor the upper reaches of the Petitcodiac following the opening of the causeway gates. Should unacceptable densities be encountered, field application would occur.

ii) Downstream of Causeway

Public concerns have been raised regarding the potential of the trial gate opening resulting in destabilization of the protective buffer of the salt marsh located downstream of the causeway on the Moncton side of the river. In considering the pre-trial flushing and the actual trial gate opening, the greatest potential (energy level) for erosion downstream of the causeway would occur during the pre-trial flushing phase of the project. However, it must be noted that flushing action occurs yearly during the spring freshet, independently of any trial gate opening. No significant erosion of the landfill marshes or effects on the stability of the decommissioned Moncton landfill were observed during the 1998 pre-trial flushing. NBDOT will coordinate the monitoring of potential erosion and/or sedimentation sites on a daily basis during the pre-trial flushing and trial gate opening phases. A log of this information will be kept for future reference. In the event of a potential erosion problem, this will be communicated to the NBDOT District Engineer who will immediately contact the Engineering and Design Working Group. The E&DWG will analyze the situation and make recommendations to the Steering Committee based on the potential for erosion and on the need for reversibility of the trial gate opening.

Overall, the potential effect of the project on the wetlands of the Petitcodiac River is considered to be not significant.

3.5 Sediments

i) Sediment Patterns

The wide natural variation in suspended sediment concentration over both time and space in the upper Bay of Fundy system will likely mask any changes resulting from modifying the flow in the upper Petitcodiac River (Schell, in MWG, 1998). No measurable effect is likely.

SPM readings in the river channel just upstream of the causeway are expected to fluctuate cyclically above the present levels during the trial period as a result of the incursion and excursion of sediment-bearing salt water.

ii) Sedimentation Upstream of Causeway from Saltwater Intrusion

Prior to the trial gate opening, pre-trial flushing will rid some of the sediment deposits accumulated upstream of the causeway. During the trial gate opening, the extent of sediment deposition upstream of the causeway due to tidal water intrusion will be limited to the confines of the headpond (low water) channel. The trial gate opening plan indicates sediment deposition would not be allowed to occur beyond the target headpond elevation of 2.5 metres. The gate operation plan identifies guidelines to deal with sedimentation.

iii) Erosion Immediately Upstream of the Causeway

Pre-trial mud flushing and channel cutting will be required prior to the start of the trial gate opening. The upstream mud flushing undertaken in 1998 by drawing the head pond down resulted in a low water channel forming near the right bank on the Riverview side of the approach channel to the Petitcodiac Causeway. The erosive action of the Petitcodiac River discharge produced a steep embankment as the water scoured the channel bed down and cut into the channel bank. This erosive action resulted in some bank undercutting and slumping along a portion of this low water channel. NBDOT personnel observed and surveyed the area and found the bank erosion site to be well within the headpond's normal high water boundary. Observations of the formation of the low water channel upstream of the causeway during the 1999 mud flushing is to be monitored so remedial action as necessary can be taken.

During the trial gate opening, there will be small amounts of salt water intrusion into the headpond during every tide cycle. The salt water will travel upstream of the causeway at small velocities when the tide is slightly higher than the headpond, but below the target 2.5 m headpond elevation. Water velocities during the upstream tidal flow are anticipated to be several orders of magnitude lower than during flow velocities associated with current mud flushing spilling requirements.

vi) Sedimentation Downstream of the Causeway

The proposed trial gate opening will not significantly change the amount or duration of either saltwater or freshwater input in comparison to the current operation of the causeway gates. There was some sediment deposition noted in front of the Tidal Boat Park in April 1998, prior to the attempted flushing in June. Later in the year, much of this deposition washed away. There is no apparent relationship between the observed sediment deposition and the pre-trial flushing. It should also be mentioned that the 1992 AQI report (Hydraulic section) predicted that even if the status quo of the gate operation is maintained, "more siltation and river bank movement ... (occurring) ... immediately downstream of Cunningsville Bridge" would result. Therefore, sedimentation downstream of the causeway will not change significantly as a result of the pre-trial flushing and the trial gate opening.

vii) Erosion Downstream of the Causeway

The proposed trial gate opening is not expected to significantly change the combined salt and freshwater volume going out with each tide. The 2.5 m limit placed on the headpond water level during the trial gate opening will only permit a modest tidal prism to flow upstream of the causeway. There may be, as outlined in the gate operation plan, more frequent mud flushing than would occur with the status quo gate operations. During the attempted flushing in June 1998, some shoreline slumping was reported along a section of Riverfront Park. This was inspected by NBDOT and E&DM/G members and the conclusion was that the slumping of the bank could be expected independently of the flushing effort related to the trial gate opening. NBDOT will be monitoring closely this section and other downstream areas in collaboration with Town of Riverview officials.

No significant change in erosion downstream of the causeway as a result of the pre-trial flushing and trial gate opening is anticipated. Additional periodic mud flushing may occur during the trial gate opening as a result of rainfall events. However, it would not be as substantial or as sustained as freshet flushing.

viii) Infrastructure Integrity

Public concerns have been raised as to the impact the trial gate opening could have on the integrity of downstream infrastructure such as the causeway and its control gates, the Cunningsville bridge piers, the water mains, and sewage outfall pipe. The pre-trial flushing and limited trial gate opening is not expected to increase significantly the volume or velocities of the tidal regime below the causeway. Since no significant increased erosion or sedimentation downstream of the causeway is predicted as a result of the pre-trial flushing and trial gate opening, there are no identified adverse effects anticipated.

Overall potential impacts to sediments as a result of the trial gate opening project is considered not significant.

5.0 Water and Sediment Quality

a) Water

ai) Municipal Wastewater

Concern has been expressed about the discharge from the Greater Moncton Sewerage Commission treatment plant that operates at Dieppe Point, approximately 9.7 km downstream of the causeway.

The general trend for the effluent when it leaves the plant is to flow down the Petitcodiac River to the Bay of Fundy. During incoming tide however, a percentage of the treated effluent is anticipated to be carried upstream. This was confirmed by Environment Canada monitoring activities. It is also anticipated that water containing fecal coliform bacteria above the contact recreation guideline will flow through the gates on the incoming tide.

Waste water from the treatment plant on November 25, 1997 was traced using a fish toxicity test. Rainbow trout were placed in a 100% effluent sample and there were no mortalities over the 96 hour test period (N.B. DNR communication). As a consequence, the effluent would not be expected to have any toxic effects on fish.

1997 data provided by the Province of New Brunswick indicated that the Greater Moncton Sewerage Commission treatment plant is operating well within the limits established under the provincial Certificate of Approval for the plant.

There are no anticipated environmental concerns with tidal water moving into the headpond area. This would have been the normal tidal movement in the Petitcodiac River and estuary and has happened during previous gate openings. Fecal coliform material found in the Petitcodiac tidal water does not pose a threat to waterfowl as evidenced by the waterfowl observed over Dieppe Point and Canadian Wildlife Service research on the use of constructed wetlands to provide waterfowl habitat and treat municipal waste water.

The limited time frame of the experiment does not warrant the expenditure of capital resources toward the installation of disinfection processes at the sewerage treatment plant. This would probably be a consideration in a long term river restoration plan.

The only potential impact to the sewerage treatment facility during the trial opening experiment would be possible erosion around the outfall pipe. The planned flushing and limited gate opening is not expected to significantly increase the volume or velocities of the tidal regime below the causeway.

Section 35 of the *Migratory Bird Regulations* prohibits the deposit of harmful substances into water or areas which may be frequented by migratory birds. The aforementioned data suggests

[illegible] [illegible] [illegible] [

There appear to be no definitive trends evident to date in the analytical data gathered from the dump leachate seeps. Furthermore, no trend is evident when comparing samples taken at similar times of the year (i.e. spring, summer, or fall samples). It should be noted however, that the landfill closure efforts to date have had some effect on reducing the volume of leachate. While the closure plan was to a great extent aesthetic in nature, the addition of glacial till and ground cover as well as surface grading has resulted in increased surface water runoff and consequently less infiltration. It is worthy to note that in the summer months, a number of the seep sample points have shown very little leachate present. This period coincides with the timing of the trial gate opening.

The opening of the causeway gates on a temporary basis is not expected to physically impact these landfill sites. The concentration of leachate that ultimately passes through the gates will be dictated by the volume of leachate production, riverine discharge and tidal flow. The trial gate opening project will not result in increased volumes of leachate. Anticipated levels of contaminants in the headpond area during the experiment are expected to be within CCME guidelines for the protection of aquatic life. Water quality in the headpond area will be monitored to verify these predictions (See Appendix 1).

Samples were collected at Bore holes 101, 103, 104, and 107, as well as Seeps 1 to 6 and at the Peat Tank inlet and outlet. These samples were collected on October 23, 1997 and sent to Philip Analytical services for analysis. PCBs were detected in one groundwater sample, BH103, located in the west section of the landfill, at a concentration of 0.134 ppb. PCBs were either not present or were at concentrations below the analytical detection limit in all other groundwater samples.

PCBs were detected in four of the eight surface water samples (seeps) submitted for analysis. Concentrations of PCBs ranged from "not detected" (Seeps 1,2,3, and the peat tank outlet) to a maximum of 0.152 ppb at Seep 4. (See remediation criterion below). Preliminary 1998 PCB sampling results suggest that concentrations have diminished to levels close to or below laboratory analysis detection limits. The highest concentration found was 0.006 ppb at Bore Hole 103.

Samples were also collected at two locations on the Petitcodiac River (causeway and bridge), and the results of these tests were reported as "not detected". Results for benzene, toluene, e-benzene, xylenes, gasoline, fuel oils and purgeable hydrocarbons were all not detected in five sets of river samples collected between August 1, 1996 and July 30, 1997.

The CCME Freshwater Aquatic Life remediation criterion for PCBs is 0.001 ppb (which is below the analytical limit of detection of 0.05 ppb). Therefore a dilution of 150 times would be required in order for the 1997 leachate samples to comply with the guidelines. Such a dilution rate is attained and exceeded when the leachate is introduced to the Petitcodiac River, even at low flows combined with low tides.

In the spring of 1998 (April), a total of 30 samples for bore hole, seep, and peat inlet and outlet leachate samples were submitted for analysis. All results were reported as less than the detection

limit of 0.05 ppb. Two sediment samples from seepage areas were also reported as "not detected". The same dilution factor would apply to this situation.

It is, therefore, concluded that potential effects to water quality resulting from the proposed trial gate opening are considered to be not significant.

6) Sediment

a) Sediment Quality

Public concern has also been expressed about the possibility of contaminated sediments being deposited in the headpond, and potentially contaminated sediments in the headpond being deposited downstream during the trial gate opening.

Three sediment samples and one composite sample of suspended sediment were collected from the Gunningsville Bridge area. These samples were tested for toxicity in the Microtox Solid Phase Test. None of the samples were considered toxic. These samples were also tested for toxicity using a 10-day test with infaunal estuarine amphipods (*Eohaustorius estuarius*). None of the samples were toxic to the amphipods. As this sampling location lies between two of the landfills, part of the concern about landfills is addressed.

Bottom sediment from the Gunningsville Bridge area of the Petitcodiac River was collected on November 4, 1997. Because of the analytical results shown in the next paragraph, the sediment collected was frozen and has been used since that time in the Environment Canada laboratory as a "clean" sediment to maintain a culture of the amphipod *Leptocheirus plumulosus*, a small sediment burrowing organism. These cultures are held for use as test organisms for toxicity tests conducted by Environment Canada on other sediments.

For these bottom sediment samples, PCB concentrations were all <7 ng/g (ppb). These levels are all well below the ERL (Effects Range Low, a level which represents a minimal-effects range) of 22.7 ng/g (Long et al 1995). Total PCBs in the sediment samples are below the No Effect Level for freshwater sediments of 10 ng/g (interpreted as "clean, no impact on water quality uses or benthic community anticipated", OMOE 1992). Total PCBs in the sediment samples are also below the Environment Canada recommended interim freshwater sediment quality guideline for total PCBs of 34.1 ng/g (the concentration of total PCBs in the sediments below which adverse effects rarely occur), and the recommended interim marine sediment quality guideline for total PCBs of 21.5 ng/g (Environment Canada 1997a).

It is anticipated that the levels of PCBs found in the sediments would not likely cause adverse effects to organisms living in the sediments or to organisms coming into contact with the sediments.

Values measured in the same four sediment samples for the sum of individual Polycyclic Aromatic Hydrocarbons ("total" PAHs) ranged from 143 to 182 ng/g. These levels are all more than an order of magnitude below the ERL (Effects Range Low, a level which represents a minimal-

effects range) of 4022 ng/g (Long et al. 1995). Total PAHs in the sediment samples are well below the Lowest Effect Level for freshwater sediments of 2000 ng/g (Ontario has not established a No Effect Level for total PAHs. Levels above the Lowest Effect Level are interpreted as "clean to marginally polluted, potential to effect some sensitive water uses"; OMOE 1992).

It is anticipated that the levels of PAHs found in the sediments would not likely cause adverse effects to organisms living in the sediments or to organisms coming into contact with the sediments.

As no PCBs were detected in the clam samples collected from the headpond, and PAH concentrations were mostly less than detection limit, it is anticipated that the sediments present in the headpond do not pose a threat to the organisms living in the sediments. Furthermore, if this sediment were washed downstream of causeway, it is not anticipated that it would cause significant adverse effects to downstream organisms. It is concluded, therefore, that potential effects of the trial gate opening on sediment quality are considered to be not significant.

3.7 Air Quality

Some public concerns have been raised with regards to the exposure of mudflats following the drawdown of the headpond which is proposed as part of the experiment. One of these concerns relates to increased presence of dust in the air in the near vicinity of these mudflats. Verbal communication with the City of Moncton and the New Brunswick Department of the Environment did not identify any documented complaints regarding such dust incidences during previous headpond drawdowns. During the 1998 pre-trial flushing drawdown, no dust incidences were reported but ATV activity concerns were raised.

Several factors come into play in determining potential dust generation during the prolonged exposure of the mudflats anticipated during the trial gate opening. These include grain size, wind velocity, degree of exposure, use of the mudflats (i.e. ATV use), height of the mud flats above river channel water level, and vegetation (Edwardson, pers. comm.). In a report by Bray et al. (1982), the median grain size of the banks and tidal flats was reported to range between 0.015 to 0.030 mm which, according to the standard Wentworth grain size classification, falls within medium silt. Headpond mudflat sediment samples collected in 1998 were mostly fine grain sediments with percent fines (silt and clay) ranging from 93 to 98% (Jackman and Doe 1998). These fine sediments would be expected to develop a hard mud-cracked surface which would minimize wind blown sediment transport. However, vehicular traffic would disrupt this hardened surface. The Provincial Trespass Act {Section 2.1 (c)(d)(f)(g)} makes it an offense to trespass by means of a motorized vehicle in a watercourse, lake shore area, or a marsh.
The monitoring plan in Appendix 1 identifies dust near the causeway during the trial.

Mitigation: In order to minimize the potential for dust creation, a public advisory discouraging use of ATVs and other vehicles by reminding operators of their legal obligations under the Provincial Trespass Act, would help in reducing the potential for wind blown sediment transport.

Odours from decaying plant and animal life as a result of headpond drawdown have been identified as a potential concern. With limited submergent vegetation, detritus or organic sediments, odour is not expected to be significant. Some odour of decaying vegetation may be present near the beginning of the experiment. Scavenging birds and mammals will also prey upon any exposed or stranded organisms.

4. Potential Socioeconomic Effects

4.1 Consumptive Resource Use

The establishment of Environmental Effects Significance Criteria has been undertaken with full consideration of the interaction between the project and the types of consumptive resource use which take place within the boundaries of this valued environmental component. They are defined as follows:

- significant environmental effect - an environmental effect such that a community, or a recreational sector or an industrial sector, suffers on a continuous basis, loss of an opportunity to maintain enjoyment of a consumptive use at traditional levels; and

- not significant environmental effect - an environmental effect which does not result in a lasting loss of access to and enjoyment of the use of consumptive resource for any sector of society.

i) Fisheries Resources

Fishing will be difficult on the headpond during the trial gate opening period due to reduced water levels and access, though some fishing opportunity will remain in the river channel portion of the former headpond and at the mouths of inflowing tributaries.

All commercial fishing presently takes place downstream of the causeway with the exception of an occasional and minor fishery for large eels in the headpond. It is anticipated that fishing activities will continue as usual downstream of the headpond. As a result of improved fish passage efficiency, there may be a slight positive shift in the resources present downstream.

Aboriginal fishing activity presently takes place downstream of the causeway. It is anticipated that fishing activities will continue as usual, however, with improved fish passage efficiency, there may be a slight positive shift in the resources present in areas downstream of the causeway.

Potential issues that relate to the interaction of the project and consumptive resource use include the potential for decreases in populations of fish, both upstream and downstream of the causeway.

Specific issues include increased sedimentation downstream and upstream of the causeway, downstream and upstream contamination through pollution from the city and nearby landfill sites, improved fish habitat both upstream and downstream.

A high adult return of salmon in 1983 coincided with a drawdown of the headpond in 1982, thereby allowing salmon smolts to successfully pass the causeway in that year. Adequate freshwater spawning and rearing habitat is available to successful upstream migrants as the river habitat is currently underutilized.

Generating a temporary estuarine environment upstream of the causeway will improve the health of the plankton community and be more conducive to early larval development.

The potential environmental effects of the project on consumptive resource use will be directly related to the location of resource harvest, either upstream or downstream of the causeway and the effects of the project, temporally and spatially, on the species being harvested.

Although 1997 and 1998 monitoring activities will be repeated after the trial opening, to compare the pre- and post-experimental status of the scallop stock and to address fishers' concerns, the pre-trial flushing and trial gate opening is not expected to result in a measurable impact on the scallop fishery because sediment patterns in the upper Bay are not expected to display a measurable change.

The environmental effect of the project on fisheries resources is rated not significant.

ii) Wildlife Resources

The draining of the headpond will result in a reduction in the abundance of emergent vegetation that muskrats utilize as food in the upper reaches of the headpond. Lower water levels will also reduce muskrat access to stands of emergent vegetation and den sites. This reduction in habitat quality will affect a limited number of muskrats. Lower water levels will make animal foods (freshwater mussels, aquatic insects, fish) more available to muskrats and raccoons. The refilling of the headpond will have minimal impact on muskrat dens and houses. Few dens or houses will be constructed below current elevations because of the lack of emergent vegetation on the headpond basin.

Waterfowl such as ring-necked duck, blue-winged teal and migrating waterfowl which are attracted by the fresh water, might occur in lower numbers during the seven month project (pre-trial flushing and trial gate opening) period. Most waterfowl are opportunistic and adapt to annual changes in habitat conditions and, as a consequence, any displaced ring-necked ducks, mallards or blue-winged teal will likely adapt to the absence of fresh water in 1999. Several species such as black ducks, green-winged teal and some mallards would likely continue to nest in marshy areas where creeks enter the Petitcodiac system. Others may move to the Bell Marsh Ducks Unlimited impoundment which is adjacent to the headpond.

The potential environmental effects of the project on consumptive resource use will be directly related to the location of resource harvest, either upstream or downstream of the causeway and the effects of the project, temporally and spatially, on the species being harvested. It should be noted that the spring season for muskrats is from March 27 to May 17, while the fall trapping season runs from October 31 to January 30. The waterfowl hunting season runs from October 1

to December 17, with most birds using the upper reaches of the headpond during fall being migrants.

The overall environmental effect of the project on wildlife resources is rated not significant.

Overall, the environmental effect of the project on consumptive resource use is rated not significant. Project managers must ensure that the gate operation plan, which includes contingencies for suspending, terminating, or modifying the trial gate opening is adhered to. These contingencies include:

- there is immediate risk to public safety or to the structural stability of the gate structure or causeway;
- it becomes evident that silt deposition downstream of the gates and/or high freshwater flows may compromise the ability to control upstream water levels at the target elevation; or
- fish passage opportunity becomes limited

4.2 Recreation/Tourism

For recreation/tourism the Environmental Effects Significance Criteria are as follows:

- *significant environmental effect* - an environmental effect which will result in the permanent loss of a recreational facility, program or tourist attraction, which cannot be replaced within the community, resulting in a lasting disruption of the established activity patterns of the community or potential tourists; with respect to a specific water-based recreational activity, the impact would be such that there is a permanent effect on the activity throughout the Province; and

- *not significant environmental effect* - a change in an activity pattern in a specific area, when there are other areas available for use in the region, or a change which does not have a long lasting effect on an activity.

i) Recreation

The project will drain down the headpond such that water-based activities there will be difficult or impossible for the seven month project period due to water level and access issues.

The reduced water level in the headpond and reduced access to the water could potentially affect the quality of water-based recreational activities upstream of the causeway, thus reducing the overall desire to continue an activity at that location. Relocation of activities may affect the continuation of an activity within the community if it is local residents who are primarily participating in these activities.

Most of the water-based recreational activities which take place on the headpond require in excess of 2.5 m of water to safely enjoy. The nearest alternative water body is Shediac Bay, a marine environment, which is approximately 25 kilometres from the headpond.

The quality of a wilderness or outdoor recreational experience is largely a function of the level of interaction with human activity; either direct contact with other people or the result of previous human intervention. Individuals involved in outdoor recreational activities identify strongly with a "sense of place" attributed to the presence of a natural, undisturbed environment surrounding them. The quality of experience associated with a "sense of place" will depend upon an individual's ability to enjoy the surroundings without interruptions or intrusion (WMS, 1990b).

In the winter time, the frozen headpond is used for snowmobiling. The trial gate opening is scheduled to end prior to winter setting in. There is a planned snowmobiling festival on the frozen headpond for winter1999-2000. There is concern voiced that the headpond might not have time to fill before winter freeze-up. With mean December fresh water flow values of 32 cubic metres per second for the Petitcodiac River, the headpond should re-fill in less than a week.. However, if December flows are unusually low, such as those which occurred in 1997, the headpond could require several weeks to refill to normal winter freeze-up level.

Mitigation: Ensure trial gate opening is stopped early enough to permit refilling of headpond for usual winter ice cover management

No specific information related to water-based recreational activity participation levels is available, however, the headpond is known as a popular area to partake in such activities. The Shediac area is a short distance away from Moncton and could be used as an alternative location on a temporary basis for water-based recreational activities. The Irishtown Nature Park is located 10 km away from the headpond and it affords canoeing and kayaking opportunities in a natural setting. There is opportunity for recreationalists to participate in other recreational activities available in the local area as a temporary substitute for water-based activities. Once the trial gate opening is completed and the headpond is re-filled, it is anticipated the existing recreational activities on the headpond could resume.

The trial gate opening is not anticipated to have a negative effect on ospreys, spotted sandpipers, gulls, hawks, crows, and the songbirds which are present both upstream and downstream of the causeway. Several species that favor brackish estuarine habitats, including bald eagles, great blue herons, cormorants, and wintering black ducks might occur more frequently upstream of the causeway. Birdwatching opportunity should therefore not be adversely affected by the trial gate opening.

Overall, the potential environmental effect on recreation is rated not significant.

ii) Tourism

There will be no visible significant change in the water system downstream of the causeway where the Tidal Bore is located during the eight month project period.

The Tidal Bore has been mis-promoted in the past (Fitzpatrick, 1994). Disappointment with the attraction has resulted in some cases when tourists confused the Bay of Fundy tidal action and the tidal bore of the Petitcodiac River. The size of the tidal bore may not be important if the phenomenon is explained properly. The trial gate opening will not significantly increase the tidal prism in comparison to pre-causeway conditions and will therefore not have a significant impact on the tidal bore. A temporary, minor improvement might be observed if the infilling of the river channel downstream of the causeway with tidal sediment is temporarily decreased due to occasional flushing related to the trial gate opening.

The potential environmental effect on tourism is rated not significant.

The overall potential environmental effect on recreation/tourism is rated not significant.

Mitigation: It is recommended that signs be posted in the area in which water-based recreational activities generally take place informing users of the drawdown. It is also recommended that notices be placed in local newspapers requesting the cooperation of the general public during the experiment.

4.3 Land Use and Development

The Environmental Effects Significance Criteria for land use and development are as follows:

- *significant effect* - an environmental effect that results in land use and development of long enough duration to cause a change in the well-being or established activity patterns of the community; and
- *not significant effect* - an environmental effect which causes a permanent or short-term change, but does not affect the overall well-being of the community and for which alternatives to the established activity patterns affected by the change are available to the community at large.(Jacques-Whitford)

i) Residential Land Use and Development

The interaction between the project and residential land use and development will be related to the aesthetic value of the view of the headpond and its natural surroundings as well as the value of the use of the headpond for recreational purposes and how these affect property values.

The values of existing residential properties may temporarily decrease due to a potential loss of aesthetic value resulting from partial drawdown of the headpond and subsequent exposure of mud flats.

The aesthetic value of the "new" ecosystem may increase, or offset decreases of property values in the areas surrounding the headpond.

The Texas Water Resources Institute completed a study entitled "Effects of Lower Colorado River Authority Lakes on Riparian Property Values" which focused on the recreational and aesthetic value of properties surrounding Lake Austin and Lake Travis in Central Texas. Not only did the study indicate that homeowners were willing to pay premiums for houses located close to the water, it also indicated that the water level at the time houses were bought or sold strongly influenced property values. Sales prices often decreased when lake levels were six feet or more lower than normal, in part because recreational values were less apparent (Jones, L. and Lansford, N.,1995).

In a study completed by the United States Environmental Protection Agency, it was concluded that residents find the beauty and tranquillity of water, as well as fish, birds, and other wildlife, highly desirable. It was determined that the beauty of natural surroundings increases real residential property values by up to 28 percent while also enhancing the quality of life (USEPA, 1995).

Because the headpond will be drained down for a maximum of eight months and then will be returning to its normal water level, the environmental effect of the project on residential land use and development is expected to be, although of high magnitude, of short-term duration and therefore not significant.

ii) Recreational Land Use and Development

The interaction between the project and recreational land use and development will be related to the value of the use of the headpond and its natural surroundings for activities such as boating.

Without the existence of an abundant supply of water in the headpond, water-based recreational activities will be severely limited, which may result in a potential decline in use of the recreational property associated with water-based activities. The loss of water-based activities may cause an increase in participation in other recreational activities.

Because the headpond will be drained down for a period not to exceed eight months and then will be returning to its normal water level, the environmental effect of the project on recreational land use and development is expected to be, although of high magnitude, of short-term and therefore not significant.

iii) Agricultural Land Use and Development

The interaction between the project and agricultural land use and development will be related to the value of the use of the exposed mudflats for agricultural land use.

Because the headpond will be drained down for a period not to exceed eight months and then will be returning to its normal water level, the environmental effect of the project on agricultural land use and development is expected to be not significant.

Overall, the environmental effect of the project on land use and development is rated not significant.

5. Potential Effects of the Environment on the Project

The high energy tides from the Bay of Fundy which travel up Petitcodiac estuary twice a day carry with them high concentrations of suspended sediments. Every tide cycle, some of these sediments settle in the river channel and over time, layers of sediment, several metres high accumulate. Sedimentation is more pronounced during periods of low freshwater flow, typically during the summer and winter periods and the causeway blockage reduces the flushing and re-suspension capacity of the river. The resulting sedimentation has the effect of reducing the river channel and raising the hydraulic controls for the fresh water flow and reducing the tidal prism.

During the trial gate opening, sedimentation is anticipated in the river channel, both downstream and upstream of the causeway. This sedimentation, if unchecked, could result in the impossibility of operating the causeway gates in a manner which would limit the headpond water level to the planned target maximum of 2.5 m above datum. The Project Description and Gate Operation Plan produced for the trial gate opening have identified this possibility. The Gate Operation Plan identifies the possibility of utilizing higher head pond water levels resulting from rainfall events to temporarily flush sediment accumulated in the river channel. This could only be done while not (further) jeopardizing fish passage and affecting the reversibility the trial gate opening.

Hydrologic conditions could have an effect on the trial gate opening. Rain events could result in high freshwater flows and the water level above the causeway rising above the target maximum of 2.5 metres. During such events, water could even overflow onto the exposed mud flats. This would not have the same effect as tidal water, as suspended sediment concentrations in the freshwater would be several orders of magnitude below that of the tidal water. No salt water intrusion would occur.

The potential effect of the environment on the project could be significant. However, the Gate Operation Plan outlines contingency measures which will reduce this effect.

6. Cumulative Effects Assessment

The interaction of elements of the trial gate opening and existing projects and activities (e.g. landfills, sewage effluent, infrastructure) has been considered in this assessment and no significant effects have been identified.

The Environmental Monitoring Program (See Appendix 1) associated with the trial gate opening has included the collection of baseline information which takes into account the cumulative effect of all past and existing projects and activities in the study area, including construction of the Pesticodiac causeway.

There are no known future projects/activities planned for the eight month trial period which, when combined with the trial gate opening, could potentially result in significant adverse cumulative effects.

Potential cumulative effects of the trial gate opening are, therefore, considered to be not significant.

7. Potential Transboundary Effects

There are no anticipated environmental effects of the trial gate opening outside of Canada.

8. Potential Effects Related to Accidents/Malfunctions

8.1 Causeway Gates

The Petitcodiac causeway gates are operated mainly to prevent tidal flow upstream of the headpond and to control headpond flooding. During the trial gate opening, one or more gates will be fully opened for a period of time within each tide cycle to allow some saltwater upstream of the causeway. Except for pre-trial flushing and allowing saltwater upstream, the operation of the causeway gates will not depart substantially from the current operation. As identified in the ADI Report (1990), the number of gate movements logged between May and December averaged 838 for the 1988-1991 period. The number of gate movements anticipated during the April to November project period is estimated at 1040.

The lift gates are operated with electrically powered cables. There is a backup power supply should the regular power supply break down. This will not change during the trial gate opening. The NBDOT bridge inspector will continue to ensure appropriate inspection, maintenance, and repairs (if necessary) of the causeway gates and their operation.

8.2 All Terrain Vehicles

A potential has been identified for accidents related to all terrain vehicle (ATV) use of the exposed mud flats after headpond drawdown.

Mitigation: A public advisory discouraging the use of ATVs and other motor vehicles by removing operators of their legal obligations under the Provincial Trespass Act, would help in reducing the potential for ATV accidents.

[illegible] B

[illegible] of Potential Changes in the Environment Caused by the Project
(Significance of Environmental Effect: 0 = None, 1 = Insignificant, 2 = Significant, 3 = Unknown)
+ = positive effect - = adverse effect

Valued Ecosystem Component	Description of Potential Environmental Effect	Significance	Cumulative Effect	Mitigation	Residual Significance after Mitigation
Fish and Fish Habitat	Improved fish passage	+[illegible]	1		
	Sedimentation and Erosion	-[illegible]	1		
	Loss of Headpond Habitat	-[illegible]	1		
	Fish Mortality (Headpond)	-[illegible]	1		
Wildlife and Wildlife Habitat	Displacement of wildlife from headpond	-[illegible]	1		
	Attraction of wildlife to additional fish habitat	+[illegible]	1		
Endangered Species	Loss of habitat	-[illegible]	1		

[illegible]
(continued)

[illegible] Ecosystem Component	Description of Potential Environmental Effect	Significance	Cumulative Effect	Mitigation	Residual Significance After Mitigation
[illegible]	[illegible]	[illegible]	[illegible]		
[illegible]	[illegible]	[illegible]	[illegible]		
	[illegible]	[illegible]	[illegible]		
[illegible] Water Column Quality	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]		

TABLE III

Summary of Potential Changes on the Socioeconomic Setting Caused by the Project
Significance of Environmental Effect: 0=None; 1=Insignificant; 2=Significant; 3=Unknown)
+ = positive effect - = adverse effect

Valued Component	Description Of Environmental Effects	Significance	Cumulative Effect	Mitigation	Residual Significance After Mitigation
Consumptive Resource Use *Recreational Fisheries*	-headpond loss of access	-1	-1		
	-reduction of fish in headpond	-1	0		
	-increased opportunity	+1	0		
Commercial Fisheries	-sedimentation of fishing grounds	-1	0		
	-reduction of eel fishery in headpond	-1	0		
	-Increase in anadromous fish production	+1	0		
Aboriginal Fisheries	Increase in anadromous fish production	+1	0		
Wildlife Resources	Loss of harvesting opportunity (headpond area)	-1	0		

TABLE III
(Continued)

Valued Component	Description of Environmental Effect	Significance	Cumulative Effect	Mitigation	Residual Significance After Mitigation
Recreation/ Tourism	loss of recreational opportunities	-1		-post signage and advising public of drawdown -ensure refilling of headpond in time for winter activities	-1
Land Use/ Development	loss of property value	-1			

TABLE IV

Potential Effects of the Environment on the Project
(Significance of Potential Adverse Effect: 0=None, 1=Insignificant, 2=Significant, 3=Unknown)
+ = positive effect - = adverse effect

Description of Environmental Effect	Significance	Cumulative	Mitigation	Residual Significance After Mitigation
Weather (hydrologic conditions)	-2	0	Contingency measures outlined in gate operating plan; flushing of sediment	-1

TABLE V

Effects Related to Accidents/Malfunctions
(Significance of Potential Adverse Effect: 0=None; 1=Insignificant, 2=Significant, 3=Unknown)
+ = positive effect - = adverse effect

Description of Potential Environmental Effect	Significance	Cumulative	Mitigation	Residual Significance After Mitigation
All Terrain Vehicle (ATV) accidents on exposed mud flats in headpond area	-2	0	-public advisory discouraging the use of ATVs (Trespass Act)	-1
Malfunction of Gate Operation	-1	0	-NBDOT maintenance -Back-up power supply	-1

PART E

MITIGATION AND MONITORING PROGRAM

Project managers must ensure that the gate operation plan, which includes contingency and mitigation options to ensure the project proceeds as closely as possible to the terms and objectives of the MOU, is closely followed and is carried out in an environmentally sound manner. This plan includes provisions for modifying or suspending the project under certain operational circumstances.

Project Managers must also ensure that the Environmental Monitoring Plan for the Trial Gate Opening Project (see Appendix 1) is adhered to. It includes surveys of suspended sediments, sediment quality, water quality, fish distribution and abundance, and lobster and scallop fisheries.

1. Environmental Monitoring Plan

As explained in Part B of this report, an earlier draft of the Environmental Monitoring Plan (EMP) was released to the public for feedback in July 1997, and the revised EMP was accepted in November 1997. The Plan was also re-distributed prior to and at the Open House in March 1998. The Monitoring Working Group has updated the EMP (December 1998), as it is subject to frequent adjustments from its contributors. The complete EMP is appended to this report (See Appendix 1)

2. Summary of Mitigative Measures

To minimize the potential for dust creation, a public advisory discouraging use of ATVs and other vehicles by reminding operators of their legal obligations under the Provincial Trespass Act, would help in reducing the potential for wind blown sediment transport (Section 3.7).

To protect the public's health and their well-being, the posting of notices at appropriate areas and the publication of advisories to inform the public of the limited uses of the headpond area during the trial opening and discourage direct recreational contact (Section 3.6).

Ensure trial gate opening is stopped early enough to permit refilling of headpond for usual winter ice cover management. (Section 4.2)

Post signage in the area in which water-based recreational activities generally take place informing users of the drawdown. It is also recommended that notices be placed in local newspapers requesting the cooperation of the general public during the experiment. (Section 4.2)

A public advisory discouraging the use of ATVs and other motor vehicles by reminding operators of their legal obligations under the Provincial Trespass Act, would help in reducing the potential for ATV accidents. (Section 8.2)

PART F

ASSESSMENT DECISION AND COURSE OF ACTION

Based on the information gathered to date, and the results of this screening, Environment Canada and the Department of Fisheries and Oceans are prepared to conclude that significant adverse environmental effects are not likely, taking into account implementation of the identified mitigation measures.

This screening report, and the assessment findings therein, are being made available to the public for comment. Any comment received on the report and its findings within the prescribed deadline will be evaluated and considered before final assessment determinations are reached by Environment Canada and the Department of Fisheries and Oceans, and a course of action is taken with respect to the proposed project. After the public comment period, a decision document will be prepared and made available.

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APPENDIX I

ENVIRONMENTAL MONITORING PLAN FOR THE PETITCODIAC RIVER TRIAL GATE OPENING PROJECT

Background

Construction of the Petitcodiac River causeway and dam, including a built-in fishway to protect fisheries resources, was completed in 1968. It soon became apparent that the fishway was not performing adequately and the New Brunswick Department of Transportation, in consultation with other agencies, undertook renovations to the sluice gates and fishway in 1980. Over the years, gate operations have been adjusted several times in an attempt to satisfy fish passage requirements, to control ice, as well as to minimize headpond shoreline erosion. Nonetheless, Petitcodiac fish stocks have continued to decline and some, like the Atlantic salmon and shad, are now extirpated or are approaching extirpation. Concurrently, the dramatic reduction of the tidal prism since the construction of the causeway has had significant impacts upon water and sediment dynamics of the River.

In April 1995, a proposal to study the operation of the gates was submitted to the Premier's Round Table on the Environment and the Economy. The resulting report, funded by the Environmental Trust Fund, was released in February 1996 and presented various options to improve fish passage and partially restore the natural ecosystem of the Petitcodiac River.

In December 1996, the provincial departments of Transportation and Environment, and the federal departments of Fisheries & Oceans and Environment, signed a Memorandum of Understanding (MOU). This MOU provided a co-operative agreement between the federal and provincial agencies on the implementation, monitoring and evaluation of a limited trial gate opening. The MOU recognized that the trial opening was a prerequisite to identifying a long-term solution to fish passage and ecosystem issues surrounding the Petitcodiac causeway. The Steering Committee and Working Groups for the project, representing the four parties, are responsible for delivery of the trial gate opening. In addition to federal and provincial representation, the Monitoring Working Group incorporates public and municipal participation.

Currently, the gates are normally closed but are opened for variable lengths of time, singly or in various combinations, to manage headpond water-level, ice, and silt. Gate 5 is next to a fishway, and is fitted with stoplogs from April 1 to the end of November. Gate 5 is open during that period, except when the level of the tide exceeds that of the headpond. The top stoplog has a spill notch, which was designed to enhance fish passage. The headpond water level is normally maintained around 6.0 m. This target level fluctuates during periods of significant runoff. During low water flow periods, mud flushing or ice floe management, the water level can be much lower.

The trial gate opening protocol proposed in the MOU is scheduled to begin as soon as possible after the spring freshet for a maximum of seven months. After the peak of the freshet, the gates will be operated to optimize silt flushing prior to and during the trial gate operating period, to meet and maintain the experimental physical parameters set out in the 1996 MOU. The trial gate opening itself will involve the full opening of one gate at low tide and its subsequent closure during the rising tide such that the headpond water level does not exceed 2.5 m. This headpond target elevation will result in water being confined to the historical river channel within the current impoundment. The gate will re-open once the falling tide has receded to below the headpond level, thereby allowing the headpond to drain, and the cycle will repeat itself. The trial gate operation will be temporarily suspended if flood water or ice conditions require it. The Project Description and the Gate Operation Plan should be consulted for further details.

The Monitoring Working Group is responsible for developing and implementing an Environmental Monitoring Plan for the trial gate opening. The Steering Committee originally identified the monitoring of erosion, sedimentation, and physical operation of the gates as essential components of the trial gate opening. Based on the mandated responsibilities of various government agencies, as well as issues identified by public participants, there was a recognized need for broader environmental monitoring. The Engineering & Design Working Group is responsible for monitoring the physical aspects of the operation of the gates during the trial gate opening. The Monitoring Working Group oversees all other aspects of the environmental monitoring of the trial gate opening as outlined in this document.

There are three phases of the environmental monitoring of the Trial Gate Opening. The first relates to gathering background information prior to the trial gate opening. The second phase is concurrent with the period of trial gate manipulations. The third monitoring phase, the scope of which will be defined as the trial progresses, begins after the end of the trial gate opening and pertains to subsequent monitoring of the system.

This Environmental Monitoring Plan is an updated version of the Plan that was approved and released in November 1997. This Plan is intended to remain flexible, to continue to incorporate a significant component of public participation as well as the necessary adjustments that are identified as data collection proceeds. The postponement of the trial gate opening has provided an additional year (1998) of pre-trial data.

Environmental Monitoring Plan

Pre-Trial Monitoring:

- Fall 1997 and 1998 survey of river-bed cross sections (bathymetry) upstream and downstream of the causeway to monitor channel changes during the project. Transects in the same location as previous surveys. Bathymetry was determined at the Cunningsville bridge every three weeks in 1998.

- Late-fall aerial photography in 1997 to monitor changes in shoreline from Hopewell Cape to Salisbury. Late-fall aerial photography in 1998 from Fox Creek to Turtle Creek.
- Detailed monitoring in 1998 of shoreline on Riverview side from Gunningsville bridge to 500 m upstream of causeway.
- Continuous monitoring of suspended sediments in the headpond and downstream of the causeway during ice-free months during 1997 and 1998.
- Analysis of levels of suspended sediments in Shepody and Chignecto Bays (via historical (1978-1981) data, for subsequent comparison with 1999 levels).
- Monitoring of sediment quality (sediment samples, bivalve samples) upstream and downstream of the causeway in 1997. Monitoring of sediment quality (sediment samples) upstream of the causeway in 1998. This includes measuring concentrations of metals and organic contaminants (such as PCBs and PAHs) and sediment toxicity tests.
- Monitoring of water quality conditions upstream of the causeway in 1997 and 1998. This includes the determination of levels of dissolved oxygen, suspended solids, ionic constituents, nutrients, faecal coliform bacteria, metals, and toxicity testing.
- Monitoring of water quality conditions downstream of the causeway in 1997 (metals, ionic constituents, nutrients, faecal coliform bacteria and toxicity tests). Monitoring of water quality conditions downstream of the causeway in 1998 was limited to determination of faecal coliform bacteria concentrations.
- Migratory bird monitoring upstream and downstream of the causeway (Salisbury to Mary's Point), during late summer 1997 and 1998.
- Shorebird and habitat monitoring in the mud-flat areas around Mary's Point and Dorchester Cape during late summer 1997 and 1998.
- Surveys of breeding and staging waterbirds in the headpond and areas upstream to Salisbury during 1997 and 1998.
- Surveys of larval, juvenile and adult fish distribution and abundance upstream and downstream of the causeway during 1997 and 1998.
- Monitoring during 1997 and 1998 of current trends for the lobster and scallop fisheries in Shepody and Chignecto Bays, and comparisons with historical records.
- Surveys in 1997 and 1998 of benthic communities, and late-summer distribution of submerged and emergent vegetation (macrophytes) upstream of the causeway.

- Preliminary survey in 1997 of population status of freshwater mussels (two are threatened species and a endangered) in the main tributaries of the Petitcodiac River. Survey repeated in 1998 to determine the status of these species.

- Analysis of contaminant levels in tissues of freshwater clams collected in 1997. Collection and storage of soils and tissues for possible analysis of contaminant levels in fish tissue samples, to be done in the spring of 1999.

Monitoring during the Trial:

- River-bed bathymetry and shoreline monitoring, and surveys of suspended sediments, sediment quality, water quality, migratory birds, fish distribution and abundance, shore and scallop fisheries, benthic communities and macrophytes, and collection of soils and tissues to be carried out during the trial opening. River-bed bathymetry at Gunningsville bridge to be measured at least weekly.

- Dust monitoring to be provided by an Anderson Hi-Vol Air Sampler to measure total suspended particulates near the causeway.

- Survey of suspended sediments previously planned for Shepody and Chignecto Bays no longer considered necessary (see 1997 Environmental Monitoring Report by the MWG).

Post-trial Monitoring:

- Aerial photography after the closing of the gates from Hopewell Cape to Salisbury to determine changes in shoreline.

- Monitoring of contaminant levels in fish tissue samples from the lobster fishery, from soils and from freshwater clams, to be repeated in 2001.

- Other monitoring as deemed necessary, to be identified as the trial progresses.

Further descriptions of all monitoring activities are found in Appendix I.

The Monitoring Working Group has identified previous monitoring activities in the watershed which can describe historical conditions for comparative purposes. The Working Group will encourage the participation of other government departments, individuals and organizations who can contribute to the monitoring effort.

Other Monitoring Activities:

Additional environmental monitoring activities are, and have been in the past, taking place in the watershed. For example, the City of Moncton oversees landfill leachate monitoring and submits reports to the Province, the Wastewater Treatment Plant must conduct monitoring of its effluent and provide those results to the Province, the New Brunswick Department of Health and

[illegible] Community Services has compiled its Nelsonville headpond (head) volume monitoring as a recreational water body, volunteer groups such as the Swallow Creek group, the Nelsonville Watershed Monitoring Group and the Moonrise Naturalists have been collecting environmental information for their specific purposes, and various University de Moonrise researchers and consultants have carried out studies.

[illegible] Monitoring Activities Pre-Implementation

Other monitoring activities in support of the trial gate opening have been discussed with members of the public and government agencies but are currently not being undertaken. These items include the monitoring of:

- Socioeconomic impacts of the trial opening
- Possible dump leachate in Swallow Creek, at the confluence with the Nelsonville River
- Recreational fishery activity on the headpond
- Recreational boating on the headpond
- Impacts on mammals of the trial opening
- Ice formation and processes

The Monitoring Working Group recommends that these items be included in any environmental impact assessment that would be completed before any decision with long-term implications was taken regarding the manipulation of the recovery gates.

Further Descriptions of Monitoring Activities

Physical Monitoring

Sediments:

To monitor erosion and siltation, the Monitoring Working Group is compiling the archived data on the bathymetry of the Nelsonville River and riverbank erosion. The most cross-sections of the river bottom surveyed previously between Dalhouse River and Gibbsburg were surveyed in Fall 1997 and 1998. A detailed survey of the riverbank on the Riverview side from the Cunningsville Bridge to a location about 50 m upstream of the recovery was done in 1998. Low-level aerial photography was done in 1997 between Hopewell Cape and Gibbsburg, and in 1998 between Fox Creek and Turtle Creek (New Brunswick Department of Transportation - [illegible]).

To monitor sedimentation patterns, the following activities have been initiated:

a) continuous recordings of water turbidity at one site just above the recovery and at two sites below the recovery were initiated in Fall 1997 and continued throughout the no-flow months of 1998;
b) levels of suspended sediments in Shipyard and Chippewa Bays were determined from a data series collected in 1978-1981, to compare them to similar readings that were to be collected in the area during the trial opening (Fisheries and Oceans Canada - [illegible]).

To monitor sediment quality and the possibility of contaminants being recirculated in the watershed, sediment-quality surveys upstream and downstream of the causeway were conducted in 1997. Sediment samples (n=3) and a sample of suspended sediments (n=1) were collected downstream of the causeway near the Gunningsville bridge. Bivalve samples (n=7) were collected from the headpond and its tributaries. These samples were analysed for organic contaminants such as PCBs, organo-chlorines, and PAHs, as well as heavy metals. Sediments were also tested for their toxicity using the Amphipod Bioassay and the Microtox Solid Phase Assay protocols.

In 1998 sediment samples (n= 6) were collected from the headpond and areas upstream. These samples were analysed for organic contaminants such as PCBs, organo-chlorines, and PAHs, as well as heavy metals. Sediments were also tested for their toxicity using the Amphipod Bioassay and the Microtox Solid Phase Assay protocols.

Water:

Water samples were collected on a monthly basis at three stations along 11 transects (n=33) on the Petitcodiac River between Salisbury and the causeway structure during July to November 1997, and 1998. During June 1997, samples were obtained at six transects (n=18). Samples were analysed for pre-trial water chemistry, including general chemical parameters, nutrients, metals, suspended solids, and bacteria. Samples were obtained near the water surface and, when conditions permitted, at approximately mid-depth (New Brunswick Department of Environment – NBDOE). A subset of samples has been submitted for toxicity testing (EC). Dissolved oxygen measurements were also obtained when possible (NBDOE).

Water-quality monitoring activities related to regulatory programs were conducted in 1997 and 1998 (NBDOE, EC).

Water samples were collected throughout the Petitcodiac River basin during 1997-1998 by the Petitcodiac Watershed Monitoring Group (PWMG, NBDOE). These samples were analysed for general water chemistry parameters.

As part of research in the Fundy Model Forest, water chemistry data are being collected from headwater streams (EC).

Water samples were collected upstream of the causeway in 1997 (n=23) and 1998 (n=8). Samples were analysed for levels of dissolved oxygen, suspended solids, nutrients, faecal coliform bacteria, metals, and ionic constituents. Samples were tested for toxicity using the Microtox 100% Test Protocol (EC).

Water samples were collected downstream of the causeway in 1997 (n=20) and analysed for levels of dissolved oxygen, suspended solids, nutrients, faecal coliform bacteria, metals, and ionic constituents. Samples were tested for toxicity using the Microtox 100% Test Protocol (EC).

Water samples were collected downstream of the causeway in 1997 (n=12) and analysed for faecal coliform bacteria (EC).

Stream discharge data collection is continuing at Turtle Creek and Petitcodiac, two essential sites for inflow information that is required for developing a gate management plan. Discharge data from two headwater streams are also obtained as part of the Fundy Model Forest research area (EC, NBDOE).

Migratory Birds:

A migratory bird monitoring program has been implemented, using volunteer naturalists to identify bird species and activity along the Petitcodiac River from Salisbury to Mary's Point. Waterfowl surveys for nesting pairs, broods and staging birds were conducted on both sides of the Petitcodiac headpond between the Causeway and Salisbury (EC).

Shorebird population surveys were conducted in the Dorchester Cape and Mary's Point areas, as well as other important mud flats, during the fall migration period in 1997 and 1998. Monitoring included sediment sampling for invertebrates and sediment characteristics. Birds were also captured and banded to mark individuals and determine body condition. Aerial population surveys done in 1976 were repeated in 1997 (EC).

Fish:

To monitor fish passage, several activities were initiated in 1997 and repeated in 1998: a) in summer and fall, the presence of fish in the tidal waters (below the causeway) was determined using trapnets, gillnets, and boxnets, in an attempt to relate fish movements to tidal phase; b) in summer and fall, the distribution of adult and juvenile fish in the headpond and tributaries was determined using trapnets, gillnets, boxnets and/or electrofishing, as habitats dictated; c) from June to late November, the use of the fishway by adults and juvenile anadromous fish was monitored daily; d) from June to November, physical parameters such as water temperature, salinity, and dissolved oxygen, were recorded during field sampling above the causeway; e) biweekly from mid-May to August, and monthly from September to November, the use of the headpond for spawning and larval development was monitored; f) concurrently with sampling for item e), sampling of phytoplankton and zooplankton was also done to evaluate abundance and diversity of prey for juvenile fish; g) over 19,000 smolts were released in May 1998 as an enhancement effort and were tracked during their downstream migration; and h) a literature review on fish and other aquatic biota was undertaken (DFO).

To monitor fisheries downstream of the Petitcodiac River, current (1997 and 1998) population composition, abundance, and landings of lobster and scallop in the Shepody Bay/Chignecto Bay area are being compared to historical levels by logbook analyses, sea sampling, interviews with fishermen, volunteer catch sampling and an expanded scallop research survey in the upper Bay of Fundy in January 1998 and 1999 (DFO).

To monitor fish habitat, a) benthic communities and macrophyte distribution upstream of the causeway were sampled in August 1997 and 1998 (DFO); b) preliminary (1997) and intensified (1998) surveys of population status of freshwater mussels (two have threatened status, one is endangered) were conducted in the main tributaries of the Petitcodiac River (DFO), and c) samples of freshwater clams were analysed in 1997 (EC), and lobster and eel samples will be obtained in the spring of 1999 (DFO), to assess the level of toxic chemicals in invertebrates and benthic fish. Chemicals to be investigated include dioxins, furans, PCBs, PAHs, and heavy metals. Lobster and eel tissues will be processed if other monitoring suggests the possibility of tissue contamination.

Monitoring during the Trial:

Sediments:

The shoreline and bathymetry will be monitored during the trial opening, and detailed shoreline and bathymetry surveys will be undertaken after the closing of the gates, to assess the changes upstream and downstream of the causeway (NBDOT).

To monitor sedimentation patterns the continuous recording of water turbidity at one site just above the causeway and at two sites below the causeway will continue throughout the trial gate opening. The survey of levels of suspended sediments in Shepody and Chignecto Bays will not be done as planned, as it was deemed unnecessary (see 1997 Environmental Monitoring Report by the Monitoring Working Group) (DFO).

To monitor sediment quality and the possibility of contaminants being recirculated in the watershed, sediment-quality surveys upstream and downstream of the causeway will be repeated to measure organic contaminants such as PCBs, organo-chlorines, and PAHs, as well as heavy metals and sediment toxicity, at previous sampling locations (EC).

Water:

Water quality samples upstream of the causeway shall be taken at a similar number of transect locations as per the 1997 and 1998 surveys. There will, however, be only one station at each of the 11 transects as the volume of water will be substantially reduced and confined to the channel (n=11). The sampling will be done on three trips on the Petitcodiac River from Salisbury to the Causeway Structure (NBDOE).

Monitoring of water quality upstream and downstream of the causeway will be continued in 1999 (EC).

Migratory Birds:

Volunteer-based migratory bird monitoring and waterfowl surveys will be continued in the watershed. Shorebird population and habitat monitoring will be continued in 1999 (CWS).

Fish:

To monitor fish passage, all activities initiated in 1997 and continued in 1998 will be repeated and expanded during the trial gate opening: a) the presence of fish in the tidal waters below the causeway will be determined, using gillnets, in spring, summer and fall, to relate fish movements to tidal phase; b) in spring, summer and fall, the distribution of fish in the headpond and tributaries will be determined using gillnets, boxnets and electrofishing as habitats dictate; c) the use of the fishway will not be monitored during the trial gate opening as it will not be operational ; d) from June to November, physical parameters such as water temperature, salinity, and dissolved oxygen will be recorded during field sampling above the causeway; e) biweekly from mid-May to August, and monthly from September to November, the use of the headpond for spawning and larval development will be monitored; f) concurrently with sampling for item *e)*, sampling of phytoplankton and zooplankton will take place to evaluate abundance and diversity of prey for juvenile fish; g) local residents will be interviewed about pre-causeway conditions; and h) the return and upstream passage of the smolts released in 1998 will be monitored. In addition, a counting fence to be installed downstream of Salisbury will operate continuously during the trial gate opening (DFO).

To monitor fisheries downstream of the Petitcodiac River, the population composition, abundance, and landings of lobster and scallop in the Shepody Bay/Chignecto Bay area during the trial gate opening will be compared to recent (1997 and 1998) and historical figures by logbook analyses, sea sampling, interviews with fishermen, volunteer catch sampling, experimental juvenile lobster traps, and an expanded scallop research survey in the upper Bay of Fundy in January 2000 (which should still reflect any impacts of the trial gate opening) (DFO).

To monitor fish habitat the following activities are planned:

a) benthic communities and macrophyte distribution upstream of the causeway will be sampled in late summer.
b) the status of the endangered and threatened mussel species is to be determined by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC): a report submitted in 1998 to the Committee recommends that the endangered dwarf wedge mussel be declared extirpated from the Petitcodiac watershed, its only known Canadian location.
c) lobster and eel samples will be obtained in the fall of 1999 to assess the level of toxic chemicals in invertebrates and benthic fish. Lobster and eel samples will be processed if sediment or water monitoring suggests the possibility of tissue contamination (DFO).

Post-trial Monitoring:

In the fall of 1999, aerial photography from Hopewell Cape to Salisbury, and the bathymetry survey from Outhouse Point to Salisbury, will be repeated at comparable times of year as previous surveys (NBDOT).

Monitoring of water quality upstream of the causeway is tentatively planned for at least one occasion in 2000, after the trial gate opening has ended, at transect locations as per the 1997 and 1998 surveys (NBDOE). The monitoring activities related to regulatory programs will continue, (NBDOE, EC), as will the support of the water quality sampling elsewhere in the Petitcodiac River basin by the Petitcodiac Watershed Monitoring Group (PWMG, NBDOE).

In 2000, other monitoring activities will continue if deemed necessary by the Monitoring Working Group.

In 2001, monitoring of contaminants in fish tissues will be repeated if necessary, according to previous sampling protocol (DFO).